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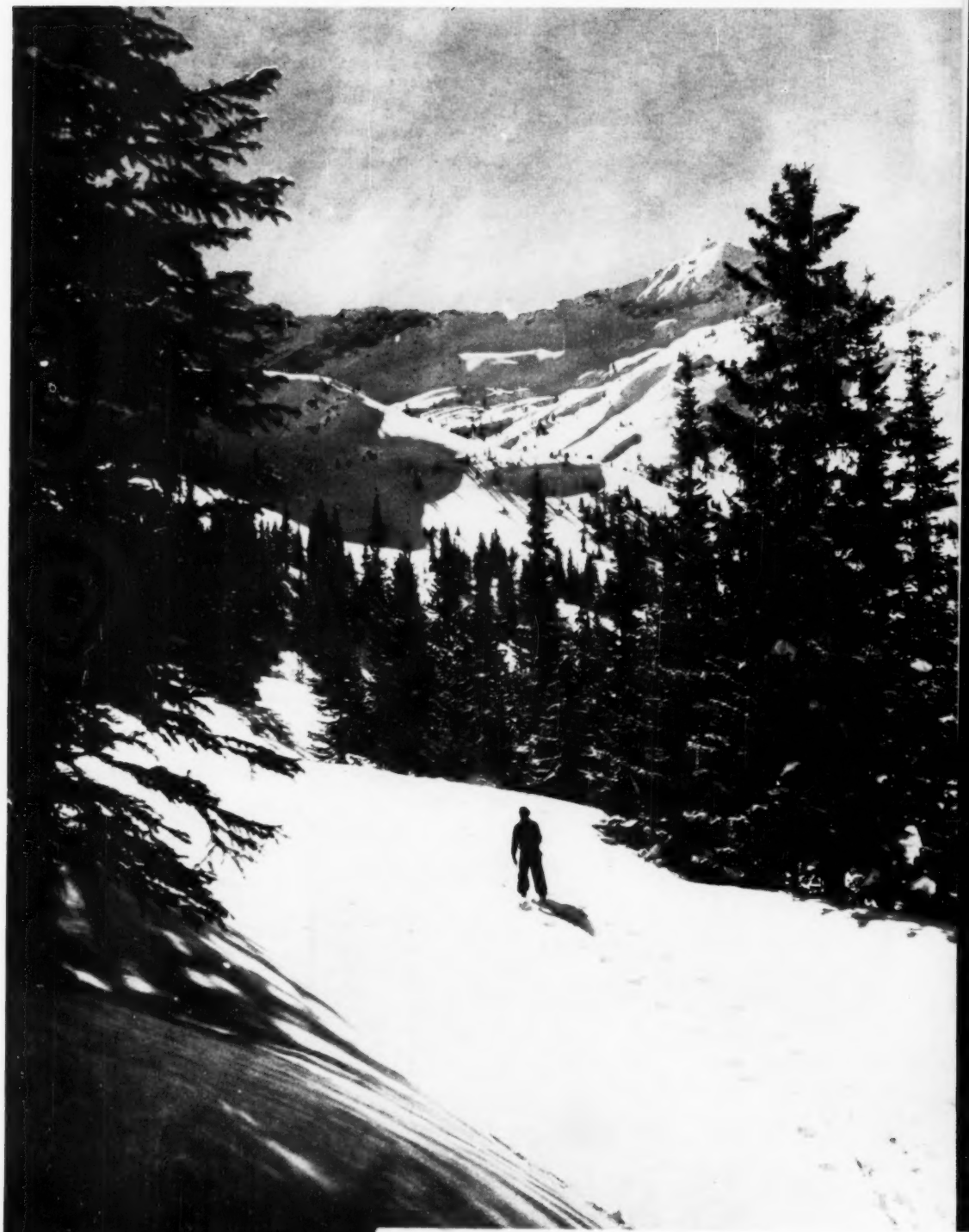
NOVEMBER 1954



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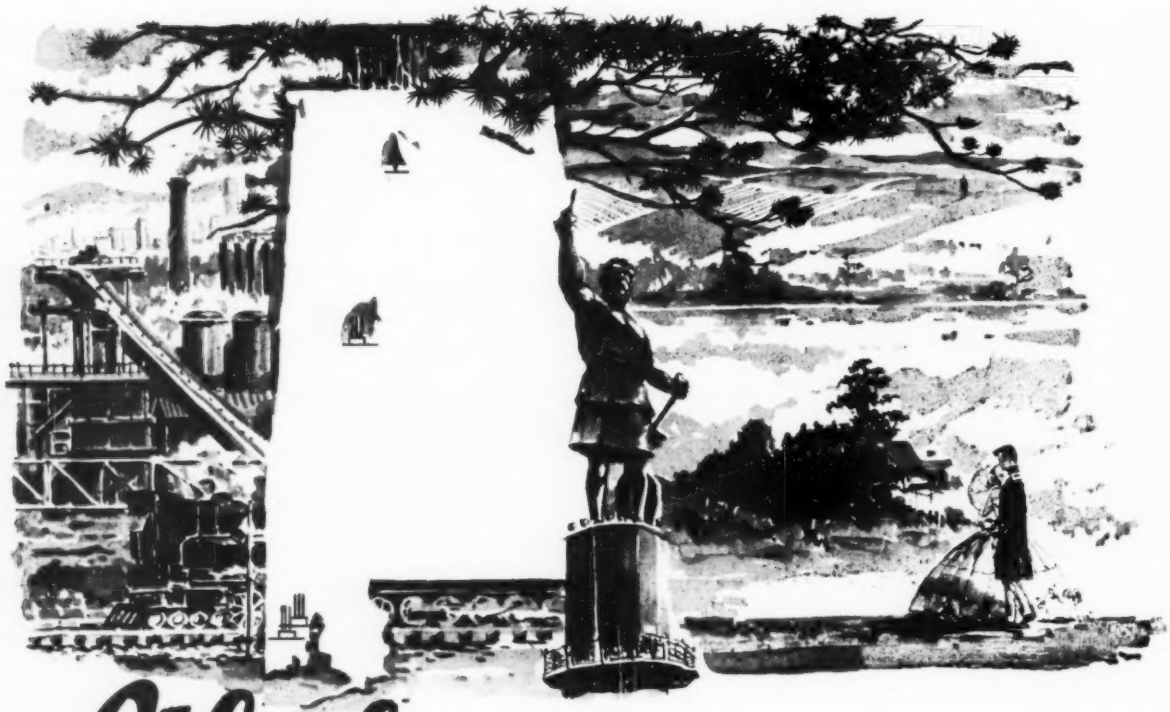

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Journal of Forestry

Official Organ of the Society of American Foresters

Problems of Winter Use on Forest Lands

F. C. Koziol
Forest supervisor, Wasatch National Forest, Salt Lake City, Utah.

ALL OF US can remember a time in the not so distant past when winter use of forest land for recreation was insignificant. I am referring, of course, to those forest lands where winter brings deep snow, prolonged cold and severe storms in the Lake States, New England, and the West. With the end of fire and hunting seasons, foresters closed their stations in the field and skeletonized the working staffs.

Highways through mountain passes often were snowed under; summer resorts closed and industries such as logging in most instances came to a halt. Except for a scattering of trappers and miners, an occasional timber cruiser and game study man, and the few hardy forebears of that fraternity which now runs into the millions, the recreational skiers, the high back country was isolated and deserted.

FIG. 1.—A trail side ski patrol rescue cache in the Wastache National Forest, Utah. Greatly increased winter recreational use of national forests has added to the responsibilities of the administrators of those lands. *Photo U. S. Forest Service.*

Increasing Winter Use

Within little more than a decade there has been a dramatic change in this picture. No certain date can be fixed for the change. It has not been universal or due to any single influence. But the fact remains that nowadays, on forest lands in many parts of the country, especially national forests and national parks where semihibernation was once the rule, winter use in terms of numbers of people, dollars invested and administrative workload is pushing that of summer recreational use.

The trend toward year-round use of the northern forests became noticeable before World War II. One signal was the construction and maintenance of all weather highways through the mountains from the Rockies to the Cascades, to the Sierras. Prior to that, of course, we had been developing winter recreational use in New England and the Lake states.

National Forest funds and engineering went into many of these roads and their feeder systems. In numerous instances trunk highways traverse national forests for many miles. The tremendous flow of traffic over them which has developed in recent years, particularly during and since the war is, indirectly at least, winter use of the forests.

Industrial and agricultural expansion in the West has also led to increased winter use in forest areas. Logging pushes farther into the back country over better roads and operates the year round. Reclamation and power projects seek the headwaters with all their related activities of transportation, communication, and housing. Many of these dams like Hungry Horse in Montana and Anderson Ranch in Idaho lie within the boundaries of national forests. The water they use to supply electrical, irrigation, and culinary needs of our western

empire is stored on national forests in the form of snow. Although the Forest Service does not have direct supervision over such projects, their existence is a form of winter use. Many of the snow surveys on which irrigations engineers base their annual plan of operation are made by foresters and woodsmen of the various cooperating agencies.

The familiar forms of transport and communication — railroads, highways, electric transmission lines and telephone lines—using the forests winter as well as summer, have been joined in recent years by two new ones: pipelines for the transport of natural gas and oil and relay stations for micro-wave radio and television. In the last there is a striking illustration of the oftentimes unexpected ramifications of winter use of forested lands. The people east of the Sierras who saw the Japanese Peace Treaty ceremonies via transcontinental TV did so by courtesy of a Forest Service avalanche man who made it possible for the telephone company to complete a key station in the relay chain, on a 10,000 peak within the Toiyabe National Forest, almost a year ahead of schedule.

In these introductory remarks I have dealt principally with general forest uses of a year-round nature which have shown marked increase in winter. Problems in connection with that are not necessarily associated directly with forest recreation—although indirectly there are many relationships. They serve to show, perhaps, that the modern day forester must be more and more the versatile individual, capable of doing many things.

Winter Recreation Use in Western Forests

The Forest Service is dedicated to utilizing under a multiple use principle the natural resources under its jurisdiction for the benefit of all the people. Of these resources, recreation, winter or summer, is certainly one of the most important. You may have heard the famous saying: "Skiing is more than a sport, it is a way of life." This sounds a little pretentious, but I think we can all agree that it is no small contribution to health and morale of the American people to discover that they can enjoy themselves in the open from November to April as well as in other seasons.

Skiing is changing the outdoor recreation habits of the nation and in desirable ways, from spectator to participant, from one-season to all-season.

Twenty-five years ago the sport did not exist in this country except as a scattered activity of small groups in the Lake States, New England, the Sierras, and a few other spots. Fifteen years ago, though snow trains were running in New England, skiing was still a sport for the few, confined to the low elevation foothills and unreliable snow conditions. The closest most people had come to it was a ski-jumping exhibition by professionals.

For example, in 1935, winter use for the entire Intermountain Region of the Forest Service, consisting of Utah and parts of Wyoming, Nevada and Idaho, was five thousand visits. Today there are several ski areas in this same region, and others, where that many people are entertained on a single week end.

I am not aware if any philosopher has ever explained why human beings love to slide, but they do. Perhaps it is an expression of the envy of man, one of God's more awkward creatures afoot, for the fleetness of the deer and the grace of the bird.

In any case, the real upsurge of winter recreation in this country began in 1936 with Sun Valley in Idaho. Originally this great ski resort was developed on private lands in the foothills. It did not become an alpine-type area, comparable to those in Switzerland, until 1939, when operations began on Bald Mountain in the Sawtooth National Forest. By that time, the honor of being the first true alpine winter sports area in the United States had already been snatched from it.

Development at Alta

In 1937 at the request of several communities and individuals, Alf Engen, one of the greatest skiers of all time, and I toured the Intermountain Region in search of favorables locations for winter sports. Most of the recommended ones, incidentally, have since been developed. Among the places we looked over was Alta, in the Wasatch Mountains just east of Salt Lake City—in the 1860's a great silver mining camp but long since abandoned. Here, we realized, was a winter sports area comparable to the Alps, with a six months skiing season, long, steep slopes near timberline, abundant snowfall of the dry type beloved of skiers, and a metropolitan area within easy driving distance. On our recommendation, the Forest Service granted permits for the development of Alta, and in 1938 it became the first big time alpine winter sports area in the western hemisphere, perhaps anywhere in the world outside the Alps themselves.

By a big time alpine ski area I mean one with lifts, lodges, transportation and all the other accoutrements of a fully developed winter resort. And I should like to remind those people who say that a bureaucratic organization is nonprogressive and unimaginative by definition, that the Forest Service by authorizing winter use of Alta walked knowingly into a complex and difficult administrative and safety problem. That was understood, though if we had known in full all the ramifications to come, perhaps we wouldn't have had the courage. In 1937 the pressure for winter use of Forest lands was not the irresistible force it became a few years later. By taking the plunge at that early date, we gained priceless experience in winter administration against the day within a few years when winter use in the Intermountain Region multiplied itself by sixty and became three hundred thousand instead of five.

In 1935 there was not a single big time winter sports development in the Intermountain Region. Now

there are 10, plus 25 small areas, and more building. The Southern Rocky Mountain Region tributary to Denver has six, with more in prospect. The Pacific Northwest has about the same number. But with the tremendous wealth and population of California to draw on, Region 5 has out-stripped all others.

For the country as a whole, winter use of forest lands in 1952 was about two million visits. For some individual forests and recreation areas, winter visitors are more numerous than in summer, a situation that, I dare say, never occurred to Marshall, Pinchot, and Teddy Roosevelt.

The foresters in charge of administration of these areas had to take a new look, learn new things and venture into solution of problems that no forestry school courses had taught them.

If you have a taste for superlatives, the United States now has the first double-chair lift in the world, the longest, biggest and, I'm sorry to say, some of the worst. There is even, believe it or not, a modern, big time winter sports development at altitudes up to eight thousand feet within one hour's driving time of Los Angeles.

Alta within the Wasatch National Forest was not only the first of the true alpine winter use developments on forest lands, it also presented us with practically all the special problems of winter administration, in aggravated form. For the latter reason, I am going to use it from here on to illustrate this discussion of some of those problems.

To begin with, a ski area requires a large amount of ground. Alta, like every mining district, was a checkerboard of land publicly owned, privately owned and in between, that is mining claims filed on but not patented. This is frequently a typical land ownership situation. Fortunately for the cause, most of the essential land at Alta not under Forest Service jurisdiction had fallen into the hands of one man, the redoubtable Mayor Watson, the self styled King of the Prospectors. In the progressive and unselfish spirit that was characteristic of him he donated needed surface rights to the Wasatch National Forest. Other individuals and companies followed suit so that it was possible to get public control of the necessary surface.

Other areas have not been so fortunate. Development of Slide Mountain, near Reno, for instance, has been held up for two years by the less public-spirited owner of a small block of key land in the midst of a Forest Service tract. It took the drastic step of condemnation proceedings to break that particular bottleneck.

The ramifications of fully developed winter use are surprising and have led to a variety of problems in policy, administration, and operation. In the time of the C.C.C. and W.P.A., the Forest Service built facilities such as Timberline Lodge on Mt. Hood and the public shelters at Alta. It even engaged in snow removal and lift operations.

Nowadays, however, the policy is to engage only in planning, training, supervision and when funds permit such field operations as protection from avalanche hazard, search and rescue, and research. Where the land is predominantly under Forest Service jurisdiction we feel that it is our task to see that the area is properly developed and efficiently operated for the service and safety of the public. For this purpose the Forest Service installed a few years ago the annual Alta Snow Ranger School, where for 10 days men from public and private agencies are trained.

The area problems then may classify themselves about as follows:

1. Planning in detail the area to be developed before any construction. Advance studies of weather and hazard factors.

2. Providing for adequate sanitation control.

3. Developing an adequate administration and safety program for such control as may be necessary in the interest of the public.

4. Access Roads. Who will build, maintain, and handle snow removal.

5. Selection of the agency to carry out the primary developments and financing.

6. Improvement of ski trails.

To fully illustrate how one area's problems were worked perhaps it would be best to stay with Alta since that area can be considered as one of the most difficult and complex to handle.

The nature of the snow, length of season, and general all around information on suitability for skiing were well understood at Alta, before any developments were authorized. The elevation in the valley is 8,500 feet. A careful lay out plan for the entire area was made by recreational planners in advance and has been substantially followed since. In the early stages of development and planning the hazard factors were not well known.

The Alta situation from the beginning created a serious conflict with sanitation control since the drainage basin is on a municipal watershed. Despite the objections of some health authorities, the public pressure for the development was so strong that it went ahead.

Incidentally the Alta ski lift development was sponsored and financed by a community group known as the Salt Lake City Winter Sports Association. There are several such associations in the intermountain area.

Presently at Alta there are three different permittees operating facilities on public land. In addition there are two lodges operating independently on private (mining) land. However, the main control lies in the hands of national forest permittees, which is fortunate. The standards for sanitation control are set up by the Health and Water officials of Salt Lake City. The Forest Service assists in their enforcement through provisions in the permits.

Chemical toilets are a standard requirement with all effluent to be transported out of the drainage area. Kitchens and bath wastes are disposed of by conventional methods, but must follow designs approved by health authorities and these are very strict. Time will not permit going into details but I

should say that the water from Little Cottonwood Creek wherein Alta is situated and which supplies about 25 percent of the total domestic needs of Salt Lake City, ranks high in purity from contamination. Its treatment by simple chlorination still meets U. S. Public Health Standards. Despite early warnings to the contrary, winter use by 75,000 skiers, under the controls in effect, has not brought about a sanitation hazard in Little Cottonwood Canyon. To provide all possible safeguards, however, Salt Lake City is planning the installation of a complete treatment and filtration plant there in the near future.

The nature of the Alta area is such that it requires an area administrator on duty constantly. The high altitude region is a breeder of sudden violent storms. The total snowfall averages 500 inches per year or 100 inches per month during the skiing season. A safety plan must be carefully developed and enforced not only with the operators under permit, but those on private lands also. The safety plan is designed not only for the skiing area itself, but for the lodges, lifts, and other facilities.

There is also the problem of the access highway, a state road, which is perhaps the most difficult and critical. The maintenance of the highway and enforcement of traffic restrictions and regulations is not a problem of the area administrator or snow ranger; however, the snow ranger is in a strategic position within the ski area itself to appraise conditions and advise the state agency. The state crews and equipment are in the valley at 4,500 feet. The snow ranger in the ski bowl at 8,500 feet where the controlling weather conditions prevail. The nine miles of access road is periled with much snow avalanche potential. Unless traffic is controlled during hazard periods, casual traffic and road crews with equipment would be exposed to grave danger. So, the snow ranger must decide when conditions are safe or dangerous and act accordingly. A heavy responsibility rests on the shoulders of a snow ranger and he must be a man with much snow and weather experience.

Ski trails or runs are generally of two types: (1) natural alpine terrain—treeless or nearly so by nature and; (2) man made trails, improved by cutting timber and removing ground obstructions. In the second group a great deal of skill and know-how is needed to: (*a*) take advantage of the terrain exposure, and snow conditions, (*b*) create runs that are most attractive and thrilling to the skier, and (*c*) most important of all avoid creating man-made avalanche traps.

Alta probably has the most complex administrative pattern of any winter sports area under Forest Service jurisdiction with the possible exception of Mt. Hood. From it we descend through all the lessening stages to the vanishing point in cases such as Aspen and Squaw Valley where only a minor amount of public land is involved and where responsibility rests directly with the land owner. It is obvious that every winter recreational use on forest lands is a little different from all the others and must be tailored to fit.

Avalanche Study

Forest Service participation in this trend toward winter use began involuntarily. It was by coincidence, not design, that so much of the most desirable skiing terrain in the western states lies within national forest boundaries. This emphasizes a serious obligation on the part of the Forest Service to guard the interests of the public or see that it is done by its permittees. We never thought it would, but it has led us into some unexpected byways: the study of avalanches, for instance—a far cry from the foresters traditional line of study. Since this involves human life and property, I would like to go into more detail.

The history of Alta during mining days foreshadowed the problem of avalanche hazard. It was a tale of annual loss of life and destruction of property.

One might ask "Why plan a winter sports development under terrain conditions that indicate the presence of avalanche hazard?" That is a good question. The answer is relatively simple; it is this: Any ski area to be of top flight character must have some terrain steep enough and sufficiently challenging to be subject to snow slides. If it is not of that type it will not interest the great mass of the better skiers. So I could enumerate a few examples; Alta, Sunvalley, Aspen, Berthaud, Arapaho, Mt. Baldy, Stevens Pass—all have portions of their skiing terrain subject periodically to avalanches.

The Swiss mountaineers offered the only precedent for management of dangers of this type. They have been working on the problem for many years and their Avalanche Institute is internationally famous. We learned that under their conditions of use, the Swiss expect from twenty-five to fifty fatal avalanche accidents per season, in spite of all precautions. It seemed to us that this, as well as the casualty rate of Alta in mining days, was rather a high price to pay for utilization of our most desirable skiing lands. Under our conditions of use, which anticipated no such concentration of people and improvements as exist in Switzerland, we set our sights on a better safety record.

Alta became the first avalanche research station outside Europe. Continuous studies have been made there for over a decade. From the first, our objective was not theoretical snow mechanics but to develop practical guides for recognition of avalanche hazard in the field early enough to take protective action.

As a corollary, we have sought techniques of counteracting hazard, such as snow stabilization by skiing and by the use of explosives. By 1949 we had made enough progress to publish a preliminary report, "The Alta Avalanche Studies". And in 1952, the Forest Service published its comprehensive manual, the "Avalanche Handbook". This booklet is available to all public and private agencies faced with avalanche problems.

This is not the occasion for a detailed discussion of avalanches. It

must suffice to say that we have made significant progress in observing and interpreting the factors which cause avalanche hazard and in our methods of dealing with that hazard. The best proof is that the development of winter use on forest lands of the alpine type, where avalanche hazard is certain to exist in some degree, has proceeded without spectacular disasters such as occurred in the past before there was any attempt at management or comparable to the losses which are accepted in Europe as inescapable.

This, by the way, is not intended as a reflection on the ability of our colleagues in the Alps. Admittedly the problem there is more severe due to the greater concentration of people and improvements in hazardous areas. I do venture the statement that winter use of public land in the manner and on the scale of today would have been impossible without the work that has been done to learn something about the snow avalanche and to reduce this hazard.

FIG. 2.—A naturally open alpine avalanche slope showing smooth surface and lack of obstructions to hold snow in place. Slopes are up to 70 percent. The ridge on the right is at right angles to prevailing winds and is a source of "wind slab" snow formations that are the breeding place of avalanches. A number of slides occur here each winter season so that strict safety measures are applied and avalanche hazard is reduced by blasting operations. *Photo U. S. Forest Service.*

Conclusion

Winter recreational use of forest lands has always exceeded summer use in certain locations such as Alta. In 1952, for the first time, it spurted ahead in some locations which have always been premier summer recreation areas. When you think of it, this trend is unique. Several million citizens actually looking forward to winter amounts to a change in national psychology.

So the problems of recreational winter use on forest lands is with us. They will remain with us and increase in magnitude and complexity. The foresters of today and tomorrow must learn how to handle them. This is a new field and a challenge to our professional administrators.

Coming Events

National Watershed Congress

Statler Hotel, Washington, D. C., December 6-7.

Western Forestry and Conservation Association

The 45th Western Forestry Conference and the annual meeting of the Western Forestry and Conservation Association will be held at the Fairmont Hotel in San Francisco, December 7-10.

Fourth World Forestry Congress

Sponsored by United Nations Food and Agriculture Organization. New Delhi, India, December 4-17.

Symposium on Rodent Control Research in the Direct Seeding of Forest and Range Lands

IN THE FIVE PAPERS which follow on the problem of rodent damage to direct seedings, the benefits from close cooperation in research among forestry and wildlife agencies are apparent. The papers point up salient features of the problem, explain the requirements of a good seed repellent and how it is developed, and give results obtained in three distinct areas—the Pacific Northwest, the Black Hills in South Dakota, and game ranges in southwestern Idaho.

The scope of the cooperative investigation is extensive, involving as it does field tests at eight research centers and ten operational units of the U. S. Forest Service; five forest districts of the Bureau of Land Management; three state forestry departments; the British Columbia Forest Experiment Station; eight of the largest lumber companies in the United States and Canada; and three sections of the U. S. Fish and Wildlife Service. Obviously, only representative papers could be used, but other reports in more detail will follow.

Seed loss to rodents is a well-known problem to foresters and wildlife managers. Poisoned bait, usually grain, scattered over the area to be seeded has been the time-honored control method. But this method, never wholly satisfactory when blanketed over extensive areas, is very often less effective when applied to small areas as typified by the modern staggered clearcut. A new approach was required which has been achieved through the outstanding cooperative effort cited here. It consists of giving the seed itself, at little or no detriment to germination, a quality of repellency or toxicity to rodents.

Because the program is still in developmental stages, it can be assumed that continuous research will almost certainly disclose other and more effective seed protectants.

Rodents and Direct Seeding

Donald A. Spencer
Biologist, U. S. Department of the Interior, Fish and Wildlife Service, Denver, Colorado.

THE FATE OF SEEDS broadcast over denuded forest and range land is precarious indeed. Not only is the seed bed unprepared, from a nurseryman's point of view, but there is little or no opportunity to modify the fertility of the soil, lessen the plant competition, or relieve drought; furthermore, the soil is often impoverished by fire or erosion that has destroyed its "A" horizon. Important as seed bed and climate may be, feeding by numerous small rodents, birds and insects on the seed and germinating seedlings reaches such proportions at times as to completely mask the other factors.

Formerly lacking effective means to protect seed broadcast in the field, the forester developed large nurseries where thrifty seedlings were grown under full protection and subsequently transplanted to field areas. This approach is still the backbone of reforestation programs, but the advance in labor and material costs in recent years is creating renewed interest in direct seeding. Numerous and intermittent studies envisioning only the killing of offending species with poisoned baits have occupied the Fish and Wildlife Service and other investigators for at least the past four decades. Valuable contributions in new rodenticides and bait application techniques[1] have further advanced direct seeding for reforestation and range improvement. For example, two new rodenticides, thallium sulphate and sodium fluoroacetate, properly formulated and distributed on a cereal grain bait will achieve 95 percent control or better of the resident rodent population. This procedure, however, fails to give lasting protection to subsequently sown tree seed for the following reasons:

1. The few rodents that survive are free to feed on the untreated tree seed, and it has been determined that as few as six deer mice (Peromyscus) per acre can largely nullify a program in which Douglas-fir seed is broadcast at the rate of one-fourth pound per acre.

2. Deer mice rapidly repopulate an area from which the resident population has been removed by poison. An area of 100 acres or less may regain its former rodent density by invasion from surrounding areas within as short a time as one month in the summer

[1]Citation and review of these past studies is not practical in this brief paper, which emphasizes seed treatment rather than rodent elimination.

and three months in midwinter. Many of the invading rodents survive despite residues of poison grain still on the ground, and repeated applications only partially correct the difficulty.

3. An effective rodent poisoning program must precede distribution of untreated seed by only a few weeks, and in late fall would find several species in hibernation, chipmunks (Eutamias), ground squirrels (Citellus), pocket mice (Perognathus) and jumping mice (Zapus). Their emergence the following spring makes necessary another application of poison bait.

A more logical approach is to have the seed carry its own rodenticide or repellent. In the case of rodenticide, only those mice survive that leave the seed alone after sublethal feedings. In such instances the rodent may associate the unpleasant physiological effect of sublethal dose with the food that bears the chemical rather than with the taste of the chemical itself. Thus, clean untreated seed may be avoided following an experience with treated seed of the same plant species.

Paradoxically, more of the seed remains to germinate when an effective non-lethal repellent rather than a rodenticide is used for seed treatment. This phenomena of "replacement of decimated populations" becomes increasingly evident as the size of the seeded area decreases. For example, on a 5 acre tract in southern Arizona there was a resident population of only 15 gray-tailed antelope squirrels (*Citellus harrisi*), but 119 were trapped and removed over a 10 month period. On this same area there were 107 white-throated wood rats (*Neotoma albigula*), but regular bi-weekly trapping for 10 months removed 682 of these rodents. A non-lethal seed treatment would be expected to "educate" the resident rodents against further feeding, but leave their populations intact to occupy the area and prevent intrusion of new individuals from the outside.

Also of importance is the fact that treatment of the seed is a more economical procedure since it avoids the added operation of bait distribution.

The first satisfactory chemical for seed treatment discovered in the course of this project was "tetramine" (Tetramethylene disulpho tetramine).[2] Field tests during the past 3 years have proven it effective in overcoming seed loss to rodents.

Tetramine was patented in August 1953 (U. S. Patent No. 2,650,186) as a rodenticide by Farbenfabriken Bayer of Leverkusen, Germany. It is a light, fine, white powder that is only slightly soluble in water, alkalies and dilute acids and moderately soluble in acetone and glacial acetic acid. Although pharmacological and toxicological studies of tetramine are incomplete, available information indicates that it is at least five times more toxic than any other poison used in rodent control. The lethal dose (LD 50%) for most mammals appears to be between 0.1 and 0.3 mg/kg.

The hazardous nature of tetramine is recognized as an unfavorable characteristic of no small importance. Precautions against breathing any dust arising from tetramine formulations or bringing seed-treating solutions in contact with skin or clothing must be rigidly observed through the use of respirators and rubber gloves. The treated seed must be handled and planted only with the protection of rubber or gum-dipped gloves. In stored sacks or bulk quantities the tetramine-treated seed could be hazardous to livestock, poultry and game, but properly broadcast it is unavailable in quantities hazardous either to domestic livestock or game animals.

Most pine seed (Pinus) and a few shrubs such as antelope bitterbrush (*Purshia tridentata*) can be treated by immersing dry seed in a one percent acetone solution of tetramine for one hour and then drying for at least 24 hours before planting or applying moisture. Acetone solutions may not be reused when treating resin-bearing seed. The viability of many seed species including spruce (Picea), hemlock (Tsuga) and Douglas-fir (*Pseudotsuga menziesii*), in fact, any species of coniferous tree seed having a high moisture content, may be severely impaired by acetone. Tetramine is unusual in that it produces its effect in very minute quantities, making it possible to employ a seed coating rather than attempt seed impregnation. Thus, the recommended formulation for all coniferous tree seed is to coat the seeds with a suspension of the finely pulverized tetramine in a 20 percent aqueous solution of yellow dextrin. The amount of tetramine in this coating solution varies with the size of the seed to be treated. With seed the size of Douglas-fir or larger, the ratio of tetramine to seed, by weight, should be 1/1000; with smaller seeds such as western hemlock (*Tsuga heterophylla*) and Sitka spruce (*Picea sitchensis*), the amount of tetramine should be doubled. While the newly coated seed is in the mixer and still moist, aluminum flake or finely powdered pigment is added to give it a brilliant color as a deterrent against bird feeding.[3]

While it is an extremely poisonous compound, tetramine has marked warning characteristics at sublethal levels. For example, caged deer mice will consume an average of 17 tetramine-treated Douglas-fir seeds when this treated food is offered the first time in unlimited quantities. All those eating more than 5 seed will be killed. If, on the other hand, the seed are offered one at a time at short intervals (duplicating the slow feeding that takes place in the field on broadcast seed), the average acceptance drops to 3½ seed, and only 20 percent of the mice die. Ear-tagging studies in the field have shown that as high as 50 percent of the small mammals may survive their

[2] As the JOURNAL goes to press, notice of a change in the manufacturer's plans makes tetramine currently unavailable.

[3] For further information on the treatment of seeds not mentioned here, requests may be directed to the U. S. Fish and Wildlife Service, Wildlife Research Laboratory, Building 45, Federal Center, Denver, Colorado.

contact with tetramine-treated seed.

Another favorable characteristic of tetramine is that it is translocated from the treated seed to the germinating seedling. In laboratory studies, deer mice refused to feed on conifer seedlings grown from treated seed. Meadow mice (Microtus), whose food consists largely of succulent growing vegetation, were killed by feeding on these tetramine-bearing seedlings, any time during the first month after germination.

Despite tetramine's almost equal toxicity to all animals on a weight basis, little hazard appears to exist for domestic pets and beneficial furbearers that might eat poisoned rodents. As in the case of rodents picking up scattered grain, the intake of tetramine from poisoned rodents that the predator eats is so gradual that sublethal warning symptoms develop. In the laboratory, predators of several species were offered all the tetramine-killed mice they would eat, and, although some of the test animals became ill, none died.

Tetramine is but the first introduction as a seed protectant under this project, and the search continues for other and less hazardous chemicals. The progress of these efforts, now well underway at the Service's Denver Laboratory, is discussed by Nelson B. Kverno.

Development of Better Seed Protectants

Nelson B. Kverno
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THE WILDLIFE RESEARCH LABORATORY at Denver, Colo., a U. S. Fish and Wildlife Service station, engages in chemical, biological, and ecological research into economic wildlife problems. Late in 1950, two members of the staff, both ecologists, were assigned full time to study the rodent factor in reforestation and range restoration. This action reactivated a project of long standing at the Laboratory. The objective was to find a chemical, rodenticide, or repellent, that could be applied directly to the seeds of trees and shrubs, a comparatively new approach to the problem. Necessarily, the investigation began with test tubes, caged native rodents and electrically controlled germination and seedling production tables. The results of this study have been the seed-treatment formulas that are the basis of the field tests reported in this symposium.

Since 1946 the Patuxent Research Refuge at Laurel, Md., another Fish and Wildlife Service laboratory, has solicited from private companies, universities, and the National Research Council, candidate compounds that might be useful as rodenticides or rodent repellents. The compounds are evaluated by feeding tests in which caged white rats are used. By January 1, 1954, a total of 4,585 compounds had been screened of which the most promising materials had been forwarded to the Denver Laboratory for further tests against native field mice. Because deer mice (Peromyscus) appear to be the principal offenders with respect to direct seeding, these mice have been used by the thousands in cage studies. In the later investigative stages of any candidate compound, other rodents found on the reforestation areas have been trapped and used in cage studies. These include meadow mice (Microtus), red-backed mice (Clethrionomys), chipmunks (Eutamias), harvest mice (Reithrodontomys), wild house mice (Mus) and a scattering of larger forms.

To qualify as a satisfactory chemical for seed treatment, the candidate compound must meet certain requirements.

1. It must:

a. Reduce the amount of seed consumed by mice by a minimum of 80 percent on first contact.

b. Be chemically stable so that seed protection is imparted over prolonged periods (6 to 12 months).

c. Be non-phytotoxic so that little or no reduction in viability results at the recommended level of seed treatment.

d. Be cheap enough, together with its formula additives, to permit economical use.

2. It must not:

a. Seal the seed against exchanges of oxygen and moisture either through its own action or that of its carrier.

b. Endanger domestic livestock and beneficial wildlife if used in field exposures.

c. Be unduly hazardous for the human operator to formulate and handle.

The term "repellent" is used in this text in a broad sense which requires definition. Strictly speaking, a repellent is something that tends to keep the repelled object at a distance without actual contact —for example, the action exhibited by opposite poles of a magnet. In this sense, tetramine and many other candidate compounds are not actually repellents, but in another sense a rodent is repelled after learning to avoid the chemical through an unpleasant experience with it.

In the preliminary evaluation of candidate repellents, wheat, which has been moistened with a 20 percent dextrin solution, is coated with a 2 percent concentration of the chemical. Twenty-five kernels of the treated wheat are then offered to each of 10 individually caged

rodents for at least 5 consecutive days. A sustaining ration also is available in the cage so an animal is not force fed. Those compounds that reduce consumption of seed by 70 percent or better are then subjected to further investigation as follows:

1. The seed treated with the 2 percent compound is planted in electrically controlled germination tables to determine any loss in viability.

2. Wheat treated with the candidate chemical at several levels under 2 percent is bioassayed, using caged mice.

3. Tree seed having an outer inedible hull is coated with a 2 percent compound of the candidate material and bioassayed.

4. Tree seed having an outer inedible hull is impregnated with the candidate chemical in solution, which deposits the repellent on or in the edible endosperm. Seed so treated must be both bioassayed and checked for loss of viability.

5. Whenever the candidate chemical is water-soluble (even to fractions of 1 percent) tree seed is impregnated during moist cold stratification.

There are two reasons for desiring to get the repellent inside an inedible hull. First, the compound will withstand more weathering with less loss of repellency, and second, it will better withstand rodent attack—the rodent with his large protruding incisors can cut through and discard the outer hull with only small amounts of a repellent coating coming in contact with the mucous lining of the mouth. By contrast, wheat has a very thin, closely adhering bran coat that is often consumed along with the endosperm, in which case coatings are as effective as impregnation of repellent chemicals. Of 16 compounds that caused a pronounced aversion when applied to wheat, only 1 produced any aversion when coated on the inedible hull of Douglas-fir seed. Each compound or seed has different characteristics and merits special treatment—an adhesive or solvent that works for one will not necessarily work for another.

Not all rodents are seed eaters—some are foragers that damage newly germinated seedlings. However, seedlings grown from tetramine-treated seed are not readily damaged by rodents because some of the chemical is apparently translocated into the vegetative portion of the seedling. For this reason, seedling acceptance tests are conducted to investigate further the potential of each new compound before it is released for field testing. Also, growing seedlings are kept under observation to determine whether or not the compound produces new latent abnormalities.

In some areas more seeds are taken by birds than by rodents. Experiments have shown birds to be so sensitive to color that they usually avoid unnaturally colored objects. In contrast, rodents apparently show no aversion to colored objects. The losses to birds can be minimized by dyeing the seed a brilliant unnatural color, another step in the final formulation of a seed treatment.

As an example of the slow and tedious work involved in the development of seed treatments, 185 new chemical compounds were received within a six month period in 1953 that rather effectively repelled the white laboratory rat. Rescreened on deer mice only 48 proved to be effective on this species. Only 13 of the 48 new compounds proved to be non-phytotoxic when applied to the seed. Extended studies of these 13 new compounds have eliminated all but three, that possess qualities justifying even the beginning of field experimentation.

Direct Seeding in the Pacific Northwest

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REFORESTATION by direct seeding in the Douglas-fir region was first tried by the U. S. Forest Service as early as 1908, but nearly all of these early attempts failed because mice ate most of the seed before it germinated.[2]

These discouraging results led foresters to resort to planting nursery-grown seedlings as a more positive method of regeneration. Hand planting costs about $25.00 per acre, for it is slow, arduous work. A skilled tree planter can cover hardly more than an acre a day. Furthermore, planting requires large investments in nurseries, careful planning, considerable administration, and close supervision of field crews. Nevertheless, it has become our most widely accepted method of artificial regeneration. By 1953, more than 410,000 acres in Oregon and Washington were in forest plantations. By contrast, only 54,000 acres have been seeded.

In the Douglas-fir region there are two distinct types of reforestation problems: (1) Large clearcut areas or extensive burns, such as Tillamook, where no seed source remains; (2) small clearcuts where rapid recovery of the brush may preclude the establishment of Douglas-fir if logging does not happen to coincide with a good seed year.

But now, with the advent of helicopters and more effective means of rodent control, direct seeding under favorable conditions

[1]Unit of the Pacific Northwest Forest and Range Experiment Station, Forest Service, U. S. Dept. Agric., Portland, Ore.

[2]Pacific Northwest Seeding and Planting Committee. Recommended Reforestation Practices and Techniques. Western Forestry and Conservation Association. pp. 69. 1953.

shows increased promise as a quick, yet inexpensive, method of getting trees on the land again. However, this cannot be regarded as a panacea for all our problems. Vegetative competition, high temperatures on blackened surfaces in new burns, unfavorable sites or exposures, and extremes in weather conditions also influence seedling establishment. Many of these limiting factors likewise affect survival of nursery-grown planting stock.

Rodent Problems

Small mammal populations on nonstocked cut-over lands in the Pacific Northwest vary widely, but have been found to range from a low of 6 to more than 50 per acre. A deer mouse (*Peromyscus* spp.) will consume as many as 200 Douglas-fir seed in a day, even when other foods are available. But perhaps more important, they collect and hoard properly sown Douglas-fir seed, thus making serious inroads on seed in a brief period. Consequently, direct seeding without effective rodent control is seldom successful.

Foremost among treatments currently used for rodent control is cereal grain bait, usually wheat, poisoned with thallium sulphate or sodium fluoracetate, commonly called 1080. A light, broadcast application of poisoned bait about two weeks before seeding kills mice on treated areas, but often requires repeat baiting in the spring, as well as treatment of ¼-mile buffer zones, which is impractical on areas of less than 100 acres.

Tetramine

In 1951 the Wildlife Research Laboratory in Denver introduced for restricted experimental use a revolutionary new compound, tetramethylene disulpho tetramine, commonly called "tetramine." This chemical (primarily a rodent repellent, but also a lethal poison) is used as a direct treatment on the seed itself, thus eliminating the need for poison grain bait.

Federal, state, and private agencies in the Pacific Northwest are completing the third consecutive year of tetramine field tests. These experiments were conducted in 20 different locations. They include a wide variety of sites, high altitude as well as sea level "fog-belt" areas, and range in size from ¼-acre to 100-acre blocks. Although Douglas-fir has been the predominant seed species, tests have also included ponderosa pine, Sitka spruce, western hemlock, sugar pine, and Jeffrey pine. Methods used were fall and spring broadcast seeding, either by helicopter or by ground crews using cyclone seeders, and some spot-seeding (planting).

Results.—Field tests of tetramine, generally, have given encouraging results. For example, in 1953 a 17-acre test under favorable conditions near Mayfield, Wash., showed 13 times as many Douglas-fir seedlings on the tract where tetramine was used as on the untreated check area. At the end of the first growing season, one pound per acre of tetramine-treated seed produced 10,397 seedlings per acre, in contrast to 793 seedlings per acre for untreated seed.

Even on areas as small as ½-acre, tetramine treatment gave excellent rodent protection as evidenced on a test near Randle, Washington in 1953. Here a pound to the acre of Douglas-fir seed produced 8,100 seedlings per acre. Eighty-nine percent of the mil-acre plots were stocked with one or more year-old seedlings. This is highly significant, because by the standard bait method of rodent control it is difficult to prevent reinvasion of small treated areas.

On the Tillamook Burn in Oregon, 100 acres were helicopter seeded in 1951 with tetramine-treated Douglas-fir at ½-pound per acre. This was an adverse site and weather was unfavorable, yet 544 seedlings per acre were produced. Tests near Olympia, Wash., on an old non-stocked clearcut, seeded at one pound per acre, resulted in 885 Douglas-fir seedlings at the end of the second growing season, even under adverse conditions.

Costs

The low cost of seeding by helicopter can be illustrated by citing the Forks Burn reforestation project covering 1,133 acres on the Olympic Peninsula. Here, cost of helicopter service alone for a single coverage was approximately $1.00 per acre.[3] On smaller projects, cost per acre, of course, increases.

To cite another example, under entirely different conditions, a 100-acre tract on Capitol State Forest near Olympia, Wash., was helicopter-seeded with tetramine-treated Douglas-fir at a total cost of $10.34 per acre, which is less than half the cost of hand-planting.[4] Total flying time for a single coverage of the square 100-acre block was only 7 minutes.

[3]Shaw, Elmer W. Direct seeding experiments on the 1951 Forks Burn. Research Paper No. 9, Pacific Northwest Forest and Range Experiment Station. 19 pp illus. December 1953.

[4]Shaw, Elmer W. Effects of tetramine used for rodent control in direct seeding of Douglas-fir, Research Note 89, Pacific Northwest Forest and Range Experiment Station. 7 pp. August 1953.

The Use of Tetramine in Bitterbrush Revegetation[1]

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FORAGE PRODUCTION on many important big game winter ranges in Idaho has been seriously reduced as a result of fire, insect depredation of overuse by livestock and/or big game. Formerly productive browse ranges are now dominated by cheatgrass (*Bromus tectorum*) and other low value annuals. Depletion on these ranges has been so severe or complete that natural recovery is unlikely for generations. More rapid restoration of forage species is needed. The possibility of accomplishing this by artificial measures of revegetation has received a great deal of attention and stimulated much interest.

In 1949 the Idaho Fish and Game Department undertook a project to restore browse on principal winter ranges of southwestern Idaho. Bitterbrush (*Purshia tridentata*) was used because of its known adaptability to existing site conditions and because the seed was plentiful and easy to handle.

Seeding bitterbrush in the fall has to date proved more practical than spring seeding and was used in all operations. However, it posed a serious problem—that of exposing the seed to adverse natural factors for a period of four to six months.

Use of Untreated Seed

Results of the early seeding efforts were poor. Seedlings emerged from less than 5 percent of the seed hills. Roden depredation was observed but its degree of seriousness was not readily apparent. To further determine the extent of rodent activity, hills of seed were planted in several locations within a general area where reseeding was planned. Disturbance, to the extent that hills were dug into and most or all of the seeds removed, was heavy in all areas. Within 48 hours after seeding, from 60 to 90 percent of the hills had been disturbed and in six days 98 to 99 percent had been dug into. Snap trapping revealed that the rodents present were primarily deer mice (*Peromyscus maniculatus*), with some pocket mice (*Perognathus* spp.) and harvest mice (*Reithrodontomys* spp.).

Use of Poison Bait

Control of these rodents was tried by applying two different poisoned baits. One application of sunflower seed treated with thallium sulfate was made before seed planting and another of steamrolled oats treated with 1080 was made in late fall after seed planting. These treatments did not prove effective as a great deal of mouse disturbance still occurred. The complicated conditions of weather, terrain and accessibility made it impossible to apply these poisoned baits in the most efficient way or at the most effective time. This procedure also involved two operations entirely independent of the actual seeding and each application cost $1.50 to $2.50 per acre. Some other more efficient rodent control measure was surely needed.

Use of Tetramine

Assistance from the Wildlife Research Laboratory of the Fish and Wildlife Service was requested in solving this problem. They suggested the possible use of a tetramine formulation applied directly to the seed and cooperated in a program to test the compound for protecting bitterbrush reseeding. In this introductory field trial bitterbrush seed was treated with tetramine in an acetone solution. Electric plant table tests were made to determine the effect of tetramine treatment on the seedling production capacity of the bitterbrush seed. Results averaged 87.2 percent for the treated seed and 87.7 percent for the untreated seed. Another comparison was made under typical field conditions on a winter range near the mouth of Mores Creek about 15 miles east of Boise. On December 2, 1952, 21 pairs of hills were planted, with 10 seeds per hill. One hill of each pair was planted with treated seed and the other with untreated seed. Each hill was protected by a mouse-proof wire dome. Again, no material difference in seedling production capacity was indicated. Seedlings emerged from 51 percent of the treated seeds or 90 percent of the hills as compared to seedlings from 57 percent of the untreated seed or 95 percent of the hills.

On the same date, 20 acres in the area mentioned above were seeded with tetramine-treated seed and a one-acre control plot 300 yards away was seeded with untreated seed. The seeds were planted three-quarters of an inch deep in hills at regular intervals throughout both areas, with 5 to 15 seeds planted per hill. Approximately two months after seeding, examination of several hundred hills in both areas disclosed that only one hill of treated seed had been disturbed by rodents whereas *every* hill in the control had been dug into. Near the single excavation of treated seed only one seed was found and the seed coat of that had been opened by rodents and only a minute portion of the embryo eaten away. This was in contrast to findings near planted spots of untreated seed where numerous seed coat fragments were discovered from which all the embryo contents had been removed. Near many of the excavations in the control area no seed coat fragments were found, suggesting that whole seeds had been exhumed and carried away.

At the peak of emergence during the following spring a check

[1]A contribution from Pittman-Robertson Project 88-D, Idaho Fish and Game Department in cooperation with the Wildlife Research Laboratory, United States Fish and Wildlife Service. The cooperation of Milton O. Robinson, Branch of Predator and Rodent Control, Idaho District, of the Fish and Wildlife Service is gratefully acknowledged.

showed seedlings in 86 percent of the hills of treated seed and in only one percent of the hills of untreated seed.

Livetrapping operations indicated that tetramine, although a deadly poison, did not eliminate the rodent population in the treatment area. In five nights of trapping during late October, five weeks before seeding, 39 mice of the three species mentioned previously were taken, tagged and released. During three nights of trapping in December, two weeks after seeding, 20 mice were taken, three of which had been tagged in October. Then again in March, three and a half months after seeding, trapping was carried on for three more nights. A total of 52 mice was taken this last time, of which five had been tagged in December and three in October. There were 95 live traps used each night of trapping.

In summary, tetramine was demonstrated to have no material effect on the germination of bitterbrush seed. Preliminary field work indicates that treating with tetramine affords a definite protection to bitterbrush seed where otherwise near total rodent damage would occur. Practically no treated seeds were damaged even though there was a continuous population of mice. A portion of this population was known to be resident throughout the period of seed availability. These facts suggest possible repellent qualities of tetramine.

Because of these encouraging results, the program of further testing tetramine for protecting range reseeding against rodent damage is being continued and expanded this current growing season, exploring the use of new treating techniques and the effectiveness of use in other localities.

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Ponderosa Pine Seeding in the Black Hills

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REFORESTATION of burns has been an objective on the Black Hills National Forest since its establishment in 1898. The forest has always been plagued with extensive burned areas, lacking in pine (*Pinus ponderosa*) reproduction—the principal conifer in this forested area.

Beginning as far back as 1905, direct seeding was used in the reforestation of the Black Hills. As a contrast with nationwide experience in direct seeding of forest species, efforts in the Black Hills have met with unusually high success. For example, of the 9,911 acres seeded to ponderosa pine through the period 1905-1916, 55 percent were classified as successful plantations. Perhaps the outstanding factor favoring seedling survival in the region is the light but often well-distributed moisture received in the wet spring snows and summer showers. This, coupled with periods of low rodent population, no doubt played an important part in the early success of direct seeding.

Although much direct seeding has been done in the Black Hills, primary reforestation effort in recent years has been the planting of 1-1 and 2-1 ponderosa pine seedlings. Spring spot seeding costs about $10 per acre or about one-fifth the total cost of hand planting. This is reason enough to shift from hand planting to direct seeding if the hazards of seeding can be reduced.

The above factors of rainfall and rodent pressure are quite variable from year to year. The purpose of present studies has been to reduce the element of "chance." It appeared that the rodent problem could be solved by using a protective chemical seed treatment and that some of the adverse factors of seed bed and drought could be avoided by improved seeding techniques.

At the request of the Black Hills National Forest, the Wildlife Research Laboratory at Denver, Colorado, joined in a cooperative program to field-test new seed protectants in 1952.

The Study

The 10-acre experimental seeding plots were established on three ranger districts located near Pactola, Nemo and Sundance (Bearlodge). Prior to the seeding program the rodent population was checked with snap traps. In the area of heaviest rodent population, near Nemo, 100 trap nights took 59 deer mice, 1 chipmunk, 1 meadow mouse and 1 red-backed mouse. Checks in the other seeding plots showed that rodent populations there were high enough to destroy most of the unprotected seed.

The test plots in 1952 proved without doubt that tetramine treated seed gives very adequate protection to seed during the period of germination. On all three ranger districts stocking of seed spots, in which tetramine treated seed was used, exceeded 50 percent and ranged upward to 80 percent. On these plots stocking was well in excess of that found on plots where untreated seed had been protected by pre-baiting the area with tetramine treated wheat and strychnine treated oats. On the latter plantation, 5 pounds of strychnine-treated oats were used per acre in an unsuccessful effort to wipe out the rodent population.

The seeding tests were continued in 1953. Although the previous year's experiments used pine seed treated with tetramine acetone as the protective agent, in 1953 a portion of the seed was given an overcoat of tetramine in yellow dextrin. This is a cheaper method, because of the reduced amount of tetramine required and, although dextrin is water soluble, it can be

TABLE 1.—SEEDLING PRODUCTION OF SPRING-PLANTED PONDEROSA PINE ON THE BLACK HILLS NATIONAL FOREST

District	*Control*		*Tetramine-Acetone*		*Tetramine-Dextrin*	
	Seed spots (1 or more seedlings)	Total seed-lings	Seed spots (1 or more seedlings)	Total seed-lings	Seed spots (1 or more seedlings)	Total seed lings
Nemo	0%	0	64%	233	76%	292
Bearlodge	4%	4	65%	187	87%	291

used for spring spot seeding in the Black Hills. No trap lines were run in the 1953 tests. However, a 5-acre control plot with the attendant loss of unprotected seed clearly demonstrated the presence of a damaging rodent population. The results of the 1953 season were even more impressive to local forest personnel. It was apparent that tetramine protected seed would germinate under field conditions where most unprotected seed was destroyed by rodents. It was also found that better results were obtained by using tetramine-dextrin treated seed. Table 1 gives the 1953 germination results, based on weekly examination of staked seed spots.

The 1954 spring seeding program included spot seeding on 335 acres of burns. All seed had been treated with tetramine dextrin paste. On planting sites where soil was very thin, the selection of seed spots was made with care to take advantage of the most favorable growing sites. These included areas of deepest soil and, on south and west slopes, shade protection to the seedlings by locating seed spots on the north side of stumps, down logs, and shrubs.

The tetramine treated seed studies for the Black Hills which have been reported were concerned exclusively with spot seeding of ponderosa pine seed in the spring. Other fall tests have been made using both broadcasting of seed and spot seeding in aspen and hazel brush stands but results are not conclusive.

Summary

1. Light, but well distributed moisture during the spring and summer favors ponderosa pine seedling survival in the Black Hills. However, rodent pressure is a serious factor in successful germination of seed.

2. Tests run in 1952 on three experimental seeding spots using tetramine-acetone treated ponderosa pine seed proved that this seed treatment gave good protection to seed. Results obtained were much better than on plots where clean seed had been spot seeded in areas prebaited with tetramine treated wheat and strychnine treated oats.

3. Tests in 1953 used two methods of tetramine application to ponderosa pine seed. They were tetramine-acetone and tetramine-dextrin. Seedling production was greatest where tetramine dextrin was used and seedlings germinated on 76 percent and 87 percent of the Nemo and Bearlodge plots.

TREE IMPROVEMENT SPECIALISTS in the Southeastern and Southern Forest Experiment Stations at a 2-day conference at Lake City, Fla., during which research at other centers and the newly created Southern Institute of Forest Genetics was considered. Those pictured are: (*front row l. to r.*) K. B. Pomeroy, H. A. Fowells, K. W. Dorman, W. H. D. McGregor, and B. W. Henry. (*Back row l. to r.*) R. E. Schoenike, C. E. Ostrom, P. C. Wakeley, R. M. Allen, J. C. Barber, François Mergen and P. E. Hoekstra. The Plantation is a 9-year-old progeny test of high-gum-yielding slash pines pollinated by Dorman in 1944.

Some Financial Aspects of Managing Black Cherry in Northwestern Pennsylvania

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IDEAL CONDITIONS for the management of black cherry exist in northwestern Pennsylvania. Regeneration is good and under proper silviculture reproduction can be favored. Tree growth is rapid and there are no serious diseases or insect enemies. However, glaze storms cause considerable damage and must be recognized in any management planning. Since the region lies in the heart of a highly industrialized, densely populated area it is ideally located with respect to markets. Black cherry lumber prices have been consistently high and the species is in constant demand. Large quantities are used for pulpwood and hardwood distillation, principally because of the volume available. Land costs and taxes are low and an adequate supply of labor is available. These factors combine to make the region ideal for the intensive management of black cherry.

Effective management is controlled largely by financial considerations. The choice of which trees to cut, when to cut them, and which product to put them into are decisions the forest manager must make continually. Within the bounds of good silviculture the ultimate decision becomes financial.

The value of the wood content of a tree is not merely a function of its volume. Two trees of exactly the same volume can have widely differing values depending on the form of utilization and the quality of the wood. Black cherry is no exception in this respect. In managing the species, the forester will have considerable latitude in the returns he can realize from cutting. With knowledge of individual tree values, maximum returns from cutting can be earned by judicious choice of trees and markets.

Effect of Grade and Form of Utilization on Tree Values

Log grades, based on the grades of lumber that can be recovered from them, are coming into common usage. The basis of grading hardwood logs, according to a system developed by the Forest Products Laboratory, is a framework of minimum sizes and positions in the tree, secondarily governed by defects (*2*). This grading system is applicable to black cherry. Small trees can have only the lower log grades even if no defects are present, while larger trees can have high log grades even with some defects. There is a wide differential in the values of lumber of different grades which should be carried over into the values for the different log grades. A fairly small difference in volume between two trees may be overshadowed by a wide difference in value due to this difference in grade.

The value of a tree also depends on how it is utilized. A given unit of wood as it comes from the forest has a range of values because the selling price of this wood in different forms will vary.

Value has a nebulous meaning unless more rigidly defined. An excellent means of expressing the value of a tree has been found to be in terms of conversion returns, which are that part of the sales value of a tree remaining after the total costs of production have been deducted at some common point. This residual includes the stumpage price plus a margin for profit and risk.

The conversion returns estimated as obtainable for the average black cherry tree per d.b.h. class, if the volume was converted into pulpwood, saw logs, or veneer logs were calculated. Table 1 and Figure 1 show the conversion returns avail-

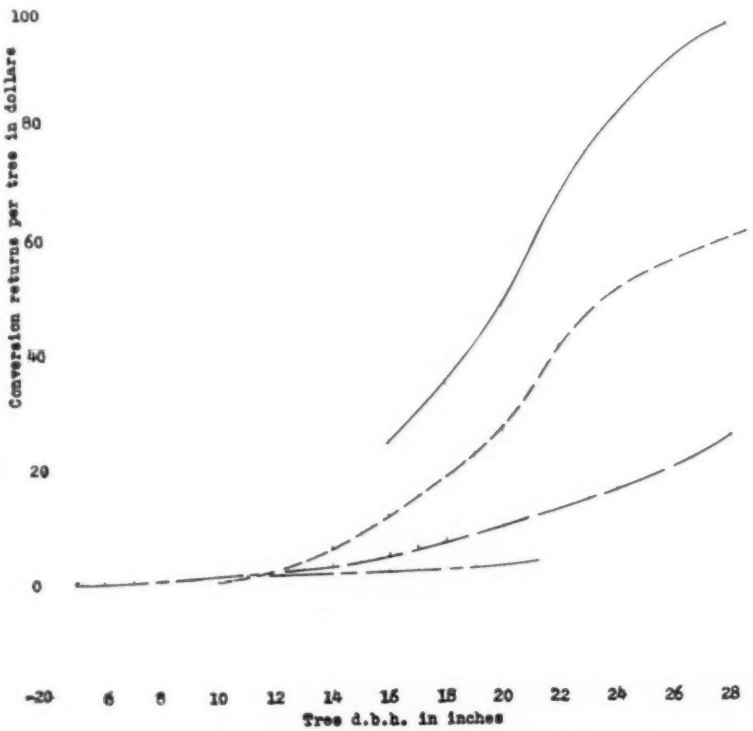

FIG. 1.—*Top:* If first log is used for veneer and remainder of tree is used for lumber, logs are all highest grades possible. *Second from top:* Used for lumber if tree contains highest grade logs possible. *Second from bottom:* Used for lumber if tree contains all grade 3 logs. *Bottom:* Tree used for pulpwood.

TABLE 1.—ESTIMATED CONVERSION RETURNS OF BLACK CHERRY PER D.B.H. CLASS WHEN USED FOR DIFFERENT PRODUCTS, NORTHWESTERN PENNSYLVANIA, 1950

D.b.h.	Average volume Per tree		Conversion returns in dollars Pulpwood Per cunit	Pulpwood Per tree	Saw logs Highest grades PerM.b.f.	Highest grades Per tree	Grade 3 Per M.b.f.	Grade 3 Per tree	Saw logs and veneer logs[1] Per M.b.f.	Saw logs and veneer logs[1] Per tree
Inches	*Bd. ft.*	*Cunits*[2]								
5	....	.026	−9.62	−.25	.....	.....	.....	.....	.....	.....
6	....	.045	−6.44	−.29	.....	.....	.....	.....	.....	.....
7	....	.067	−3.58	−.24	.....	.....	.....	.....	.....	.....
8	....	.092	— .76	−.07	.....	.....	.....	.....	.....	.....
9	....	.120	1.50	.18	.....	.....	.....	.....	.....	.....
10	44	.150	2.73	.41	−2.50	−.11	−2.50	−.11	.....	.....
11	69	.185	2.92	.54	6.52	.45	6.52	.45	.....	.....
12	99	.222	2.88	.64	13.33	1.32	13.33	1.32	.....	.....
13	133	.259	2.97	.77	20.90	2.78	13.38	1.78	.....	.....
14	172	.279	3.00	.91	29.36	5.05	11.92	2.05	.....	.....
15	215	.303	3.00	1.05	35.77	7.69	14.84	3.19	.....	.....
16	267	.350	3.00	1.18	41.12	10.98	14.91	3.98	87.04	23.24
17	325	.395	3.00	1.35	43.29	14.07	15.60	5.07	92.43	30.04
18	385	.448	3.00	1.51	45.04	17.34	16.47	6.34	87.43	33.66
19	450	.504	3.09	1.72	46.49	20.92	16.49	7.42	87.95	39.58
20	520	.557	3.10	1.92	49.23	25.60	17.02	8.85	89.64	46.61
21	590	.....	.....	.....	55.64	32.83	17.51	10.33	98.30	58.00
22	670	.....	.....	.....	59.85	40.10	17.69	11.85	98.49	65.99
23	750	.....	.....	.....	60.55	45.41	17.88	13.41	98.90	74.18
24	840	.....	.....	.....	58.69	49.30	17.62	14.80	93.81	78.81
25	920	.....	.....	.....	57.15	52.58	18.02	16.58	93.77	86.27

[1]First log veneer grade, remainder of tree highest grade sawlogs.
[2]Cunit equals 100 cubic feet.

able per d.b.h. class for certain representative examples. It would be too lengthy to present the conversion returns for all possible log grade combinations, so only three possible conditions are shown: (1) all logs in tree of highest grade possible, (2) all logs in tree of lowest grade possible, (3) first log veneer grade, remaining logs highest grades possible. In addition conversion returns are presented assuming the tree is converted into pulpwood.

The production costs and selling prices are representative for the 1949-1950 period. The general procedure to arrive at these figures was as follows:

1. An average volume—d.b.h. relationship was established in board feet and cubic feet. (*3*).

2. For saw logs and veneer logs:

a. The total tree volume in each d.b.h. class was apportioned to each log in the tree using the percentages shown in the Forest Survey Field Manual for the Northeastern States (*8*). The volumes are shown in Table 2.

TABLE 2.—APPORTIONMENT OF AVERAGE VOLUME PER D.B.H. CLASS TO INDIVIDUAL LOG POSITIONS FOR BLACK CHERRY

D.b.h. class	Average volume Scribner	Average no. logs to an 8" top d.i.b.	1st log	Contents of individual logs and half logs: 1st ½ log	2nd log	2nd ½ log	3rd log	3rd ½ log	4th log	4th ½ log
Inches	*Bd. ft.*			*Board feet*						
8	19	1	19	....	.....	.....	.....	.....	.....	.....
9	23	1	23	....	.....	.....	.....	.....	.....	.....
10	44	1½	30	14	.....	.....	.....	.....	.....	.....
11	69	1½	48	21	.....	.....	.....	.....	.....	.....
12	99	2	54	....	45	.....	.....	.....	.....	.....
13	133	2	73	....	60	.....	.....	.....	.....	.....
14	172	2½	79	....	65	28	.....	.....	.....	.....
15	215	2½	99	....	82	34	.....	.....	.....	.....
16	267	3	110	....	91	.....	66	.....	.....	.....
17	325	3	133	....	111	.....	81	.....	.....	.....
18	385	3½	146	....	123	.....	89	27	.....	.....
19	450	3½	171	....	144	.....	104	31	.....	.....
20	520	4	182	....	151	.....	114	.....	73	.....
21	590	4	207	....	171	.....	130	.....	82	.....
22	670	4	235	....	194	.....	147	.....	94	.....
23	750	4	263	....	217	.....	165	.....	105	.....
24	840	4½	277	....	227	.....	168	.....	101	67
25	920	4½	304	....	248	.....	184	.....	110	74

b. The possible log grades that each size log in a tree could have were assigned for each d.b.h. class and are shown in Table 3. The highest log grades assigned depended solely on size; any lower grade could exist if defects were present. Forests Products Laboratory specifications were used to determine log grades (*2*). The diameter of upper logs were estimated from Mesavage-Girard taper tables (*5*).

c. The percentages of the different lumber grades obtainable from the various log grades were assigned for each d.b.h. class. These percentages are from a study of lumber values from graded black cherry and oak saw logs in Pennsylvania. (*1*).

d. The lumber grade yields per tree size were computed and are shown in Table 4. The volume of each log in a tree of each diameter class was apportioned to the various lumber grades using the percentages from step *c*. The total volume in each lumber grade for the entire tree was then obtained by adding the individual volumes for each log.

e. The lumber volumes were converted to dollar values using representative 1949-1950 prices shown as follows:

Lumber grade	Value per M. bd. ft. f.o.b. mill
	Dollars
FAS	160
Selects	140
No. 1 common	100
No. 2 common	50
No. 3 common	30
Veneer logs	200

f. The total costs of production per d.b.h. class were then calculated based on information in a report of the Forests Products Laboratory (*6*). Information of this type was lacking for black cherry so the relative costs developed for northern hardwoods in the above mentioned study were used as a basis for apportioning costs of producing black cherry. Ratios of the percent of cost for 16 inch trees were calculated for all the other tree sizes. The average total logging and milling costs in the vicinity of the Allegheny National Forest were approximately $45 per M. bd. ft. as obtained from local inquiry. This figure was used as the total production cost for a 16-inch tree inasmuch as this is approximately the average size of sawlog cut. The production costs for the other d.b.h. classes were then calculated using the ratios of the percent of cost at 16 inches d.b.h.

g. The conversion returns were calculated per d.b.h. class by deducting the total costs of production from the selling value and are shown in Table 5.

3. For pulpwood:

a. The converted tree value (stacked bolts in the woods) was calculated assuming a value of $12.00 per cunit. (100 cu. ft.) This value although arbitrary was arrived at by a reasonable assumption. A cord of pulpwood was worth approximately $17.00 delivered at the mill in the vicinity of the Allegheny National Forest. This cord (4 by 8 feet by 52 inches) usually contains about 100 cubic feet of solid wood. The costs of loading and hauling ran about $5.00 per cord. Deducting this cost leaves $12.00 for the value of the cord (or 100 cubic feet of wood) stacked in the woods.

b. The conversion costs of felling, limbing, bucking, peeling, splitting, and piling per d.b.h. class were calculated. These costs were based upon a wage of $1.00 per hour for woods labor. The man hours of labor were obtained from the figures given in a pulpwood conversion cost study in northwestern Pennsylvania (*7*). These hourly figures times the $1.00 per hour wage gave the labor cost per d.b.h. class.

c. Deducting the conversion costs from the converted tree value gave the conversion returns per d.b.h. class. These values are shown in Table 6.

4. The conversion returns were calculated per d.b.h. class by deducting the total costs of production from the selling value.

Table 1 shows that conversion returns for black cherry below 9 inches d.b.h. are negative regardless of product. Trees 9 to 11 inches d.b.h. have greater conversion returns from pulpwood than saw logs. From 12 inches d.b.h. up, trees have greater conversion returns if used for saw logs. Trees above 16 inches d.b.h., if the butt log is of veneer grade, are most profitable if used for this purpose with the remainder of the tree used for saw logs.

A black cherry tree 16 inches d.b.h. if used for pulpwood is worth about $1.20; if used for lumber its value varies from $4 to $11 depending on the grade of the logs; if the first log is sold for veneer its value is about $23. In the light of these values it would be most profitable to use this tree for veneer and saw logs rather than for pulpwood.

The conversion returns shown here are not fixed. They vary depending on the market price for lumber, pulpwood, veneer, etc., and the costs of production. Even though the conversion returns may vary, their relationship to each other will tend to remain fairly constant.

TABLE 3.—POSSIBLE LOG GRADES FOR AVERAGE-SIZED BLACK CHERRY TREES PER D.B.H. CLASS

D.b.h. class	Average no. logs to an 8" top d.i.b.	Possible log grades: 1st log	1st ½ log	2nd log	2nd ½ log	3rd log	3rd ½ log	4th log	4th ½ log
Inches									
8	1	3L	....	....	....	....	....	....	....
9	1	3L	....	....	....	....	....	....	....
10	1½	3L	3L	....	....	....	....	....	....
11	1½	3L	3L	....	....	....	....	....	....
12	2	3L	....	3L	....	....	....	....	....
13	2	23L	....	3L	....	....	....	....	....
14	2½	23L	....	3L	3L	....	....	....	....
15	2½	123L	....	23L	3L	....	....	....	....
16	3	V123L	....	23L	....	3L	....	....	....
17	3	V123L	....	23L	....	23L	....	....	....
18	3½	V123L	....	23L	....	23L	3L	....	....
19	3½	V123L	....	23L	....	23L	3L	....	....
20	4	V123L	....	123L	....	23L	....	3L	....
21	4	V123L	....	123L	....	123L	....	23L	....
22	4	V123L	....	123L	....	123L	....	23L	....
23	4	V123L	....	123L	....	123L	....	23L	....
24	4½	V123L	....	123L	....	123L	....	23L	3L
25	4½	V123L	....	123L	....	123L	....	23L	3L

1 = log grade 1
2 = log grade 2
3 = log grade 3
V = veneer log
L = local use log

Selection of Trees to Be Cut on an Economic Basis

The correct cutting of individual trees in thinnings or partial cuttings is of the utmost importance for the maximum present and future returns from a stand.

For maximum returns it is imperative that cutting be carried out on an individual tree basis. The selection of trees to remove in partial cuttings should be based on the silvicultural objectives but the greatest returns will be obtained if, first of all, the choice of trees to be removed is tempered by weighing their financial maturity, and secondly by putting the vol-

TABLE 4.—GRADE YIELD OF BLACK CHERRY LUMBER PER D.B.H. CLASS

D.b.h. class	Average volume Scribner	Average no. logs to an 8" top d.i.b.	Highest possible log grades by logs					Lumber grade yields all logs highest grades[1]					Lumber grade yields all logs grade 3[1]					Lumber grade yields 1st log for veneer[1]					
								FAS	Sel	#1C	#2C	#3C	FAS	Sel	#1C	#2C	#3C	FAS	Sel	#1C	#2C	#3C	Ven.
Inches	*Bd. ft.*							*Board feet*					*Board feet*					*Board feet*					
8	19	1	3					1	1	3	5	9	1	1	3	5	9	1	1	3	5	9	—
9	23	1	3					1	1	4	6	11	1	1	4	6	11	1	1	4	6	11	—
10	44	1½	3	3				2	2	8	12	20	2	2	8	12	20	2	2	8	12	20	—
11	69	1½	3	3				4	3	12	19	31	4	3	12	19	31	4	3	12	19	31	—
12	99	2	3	3				5	5	18	26	45	5	5	18	26	45	5	5	18	26	45	—
13	133	2	2	3				12	13	29	30	49	7	6	24	36	60	12	13	29	30	49	—
14	172	2½	2	3	3			15	15	36	40	66	9	8	31	46	78	15	15	36	40	66	—
15	215	2½	1	2	3			40	34	46	36	59	12	10	39	57	97	40	34	46	36	59	—
16	267	3	1	2	3			45	39	56	48	79	14	12	48	72	121	15	16	33	35	58	110
17	325	3	1	2	2			61	54	74	51	85	17	15	59	87	147	24	26	47	36	59	133
18	385	3½	1	2	2	3		68	61	87	64	105	21	18	69	103	174	28	30	57	47	77	146
19	450	3½	1	2	2	3		80	71	101	75	123	24	21	81	121	203	33	35	66	55	90	171
20	520	4	1	1	2	3		111	89	108	80	132	28	24	94	139	235	60	51	71	59	97	182
21	590	4	1	1	1	2		149	119	124	75	123	32	27	106	158	267	92	75	82	51	83	207
22	670	4	1	1	1	2		170	135	140	84	141	36	31	121	179	303	105	85	92	57	96	235
23	750	4	1	1	1	2		191	150	158	94	157	41	34	135	201	339	118	95	104	64	106	263
24	840	4½	1	1	1	2	3	202	159	175	114	190	45	39	151	225	380	126	100	118	82	137	277
25	920	4½	1	1	1	2	3	220	173	191	127	209	50	42	166	246	416	136	109	129	92	150	304

[1]These volumes were computed by multiplying the d.b.h. class board foot volumes in the individual logs by the percentages of the different lumber grades available from the various log grades.

TABLE 5.—CONVERSION RETURNS FOR BLACK CHERRY UNDER THREE ASSUMED LOG GRADE CONDITIONS, NORTHWESTERN PENNSYLVANIA, 1950

D.b.h. class	Total tree volume Scribner	Tree volume if used for veneer		Value of converted volume			Average total costs of production per tree				Conversion returns per tree		
		Veneer log contents	Saw log contents	Highest grade logs	All logs grade 3	1st log veneer remainder top-grade saw logs[1]	Entire tree used for lumber	1st log used for veneer[2] Veneer section	Saw log section	Entire tree	Highest grade logs	All logs grade 3	1st log veneer remainder top-grade saw logs
Inches	*Bd. ft.*	*Bd. ft.*	*Bd. ft.*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
8	19			1.25	1.25		.93				.32	.32	
9	23			1.50	1.50		1.12				.38	.38	
10	44			2.00	2.00		2.11				—.11	—.11	
11	69			3.75	3.75		3.30				.45	.45	
12	99			6.00	6.00		4.68				1.32	1.32	
13	133			9.00	8.00		6.22				2.78	1.78	
14	172			13.00	10.00		7.95				5.05	2.05	
15	215			17.50	13.00		9.81				7.69	3.19	
16	267	110	157	23.00	16.00	33.50	12.02	3.19	7.07	10.26	10.98	3.98	23.24
17	325	132	192	28.50	19.50	40.75	14.43	3.78	8.53	12.31	14.07	5.07	30.04
18	385	146	239	34.25	23.25	48.50	16.91	4.08	10.50	14.58	17.34	6.34	33.66
19	450	171	279	40.50	27.00	56.50	19.58	4.71	12.14	16.85	20.92	7.42	39.58
20	520	182	338	48.00	31.25	66.00	22.40	4.93	14.56	19.49	25.60	8.85	46.61
21	590	207	383	58.00	35.50	79.75	25.17	5.52	16.34	21.86	32.83	10.33	58.00
22	670	235	435	68.50	40.25	91.50	28.40	6.20	18.44	24.64	40.10	11.85	65.99
23	750	263	487	77.00	45.00	101.50	31.59	6.87	20.51	27.38	45.41	13.41	74.18
24	840	277	563	84.50	50.00	110.50	35.20	7.17	23.59	30.76	49.30	14.80	78.81
25	920	304	616	91.00	55.00	119.00	38.42	7.83	25.72	33.55	52.58	16.58	86.27

[1]Based on price of veneer logs delivered at mill and lumber prices F.O.B. Mill.
[2]Costs of production for veneer logs do not include milling.

TABLE 6.—CONVERSION RETURNS FOR BLACK CHERRY WHEN USED FOR PULPWOOD, NORTHWESTERN PENNSYLVANIA, 1950

D.b.h. class	Volume to 4 inch top d.i.b.	Conversion cost per cunit	Conversion cost per tree volume	Value of converted contents of tree[2]	Conversion returns
Inches	*Cunits*[1]	*Dollars*	*Dollars*	*Dollars*	*Dollars*
5	.026	21.50	.56	.31	—.25
6	.045	18.50	.83	.54	—.29
7	.067	15.50	1.04	.80	—.24
8	.092	12.75	1.17	1.10	—.07
9	.120	10.50	1.26	1.44	.18
10	.150	9.25	1.39	1.80	.41
11	.185	9.10	1.68	2.22	.54
12	.222	9.10	2.02	2.66	.64
13	.259	9.00	2.33	3.10	.77
14	.303	9.00	2.73	3.64	.91
15	.350	9.00	3.15	4.20	1.05
16	.395	9.00	3.56	4.74	1.18
17	.448	9.00	4.03	5.38	1.35
18	.504	9.00	4.54	6.05	1.51
19	.557	8.90	4.96	6.68	1.72
20	.619	8.90	5.51	7.43	1.92

[1]Cunit equals 100 cubic feet.
[2]At $12.00 per cunit.

TABLE 8.—ESTIMATED GROWTH, IN VOLUME AND VALUE, OF BLACK CHERRY WHEN USED FOR PULPWOOD, UNMANAGED STANDS, NORTHWESTERN PENNSYLVANIA, 1950

Present d.b.h.	Present volume	Present conversion returns	10-year d.b.h. growth	Volume 10 years hence	Conversion returns 10 years hence	Annual rate of volume growth	Annual rate of value growth
Inches	*Cunits*	*Dollars*	*Inches*	*Cunits*	*Dollars*	*Percent*	*Percent*
5	.026	—.25	1.8	.063	—.25	14.2	—
6	.045	—.29	1.9	.089	—.09	9.8	—
7	.067	—.24	2.1	.123	.20	8.4	—
8	.092	—.07	2.2	.157	.44	7.1	—
9	.120	.18	2.3	.196	.57	6.3	21.7
10	.150	.41	2.4	.237	.70	5.8	7.1
11	.185	.54	2.5	.281	.84	5.2	5.6
12	.222	.64	2.5	.326	.98	4.7	5.3
13	.259	.77	2.5	.372	1.11	4.4	4.4
14	.303	.91	2.5	.421	1.26	3.9	3.9
15	.350	1.05	2.5	.476	1.43	3.6	3.6
16	.395	1.18	2.5	.530	1.64	3.4	3.9
17	.448	1.35	2.5	.588	1.83	3.1	3.6
18	.504	1.52	2.3	.633	1.96	2.6	3.0
19	.557	1.72	2.2	.674	2.09	2.1	2.2
20	.619	1.92	2.1	.716	2.21	1.6	1.5

FIG. 1.—Conversion returns for black cherry per tree, northwestern Pennsylvania, 1950. A. If used for lumber: (1) if tree contains highest grade logs possible, (2) if tree contains all grade 3 logs. B. If first log used for veneer and remainder of tree used for lumber, logs all highest grades possible. C. If tree used for pulpwood.

TABLE 7.—ESTIMATED GROWTH OF BLACK CHERRY IN VOLUME AND VALUE IN UNMANAGED STANDS, NORTHWESTERN PENNSYLVANIA, 1950

Present d.b.h.	Present volume	Present conversion returns			10-year d.b.h. growth	Volume 10 years hence	Conversion returns 10 years hence			Annual rate of volume growth	Annual rate of value growth		
		Sawlogs[1]	Sawlogs[2]	Sawlogs and veneer logs[3]			Sawlogs[1]	Sawlogs[2]	Sawlogs and veneer logs[3]		Sawlogs[1]	Sawlogs[2]	Sawlogs and veneer logs[3]
Inches	*Bd. ft.*	*Dollars*	*Dollars*	*Dollars*	*Inches*	*Bd. ft.*	*Dollars*	*Dollars*	*Dollars*	*Percent*	*Percent*	*Percent*	*Percent*
10	44	—.11	—.11		2.4	110	1.90	1.50		15.0			
11	69	.45	.45		2.5	148	3.91	1.91		11.4	76.9	32.4	
12	99	1.32	1.32		2.5	190	6.37	2.62		9.2	38.3	9.9	
13	133	2.78	1.78		2.5	235	9.33	3.58		7.7	23.6	10.1	
14	172	5.05	2.05		2.5	295	12.52	4.52		7.2	14.8	12.0	
15	215	7.69	3.19		2.5	355	15.70	5.70		6.5	10.4	7.9	
16	267	10.98	3.98	23.24	2.5	418	19.13	6.88	36.75	5.7	7.4	7.3	5.8
17	325	14.07	5.07	30.04	2.4	470	23.26	8.13	43.50	4.5	6.2	5.8	4.1
18	385	17.34	6.34	33.66	2.3	540	29.21	9.59	52.00	4.0	6.0	4.7	4.9
19	450	20.92	7.42	39.58	2.2	605	36.46	11.09	62.50	3.4	6.4	4.3	5.1
20	520	25.60	8.85	46.61	2.1	680	42.75	12.63	70.75	3.1	5.9	3.6	4.3
21	590	32.83	10.33	58.00	1.9	745	47.35	14.10	77.75	2.6	3.7	2.8	2.6
22	670	40.10	11.85	65.99	1.7	815	50.94	15.69	83.25	2.2	2.0	2.1	1.7
23	750	45.41	13.41	74.18	1.5	880	53.79	17.54	88.00	1.7	1.2	1.7	1.1
24	840	49.30	14.80	78.81	1.3	945	56.25	19.62	92.25	1.3	1.0	1.8	1.0
25	920	52.58	16.58	86.27	1.1	1010	58.25	22.12	96.00	1.0	.7	1.0	.5

[1]If logs are all highest grades possible.
[2]If logs are all grade 3.
[3]If first log is used for veneer, remainder of tree in sawlogs, all highest grades possible.

ume into its highest value product.

Financial maturity means the point beyond which a tree will not make a profitable increase in value. The catch in the definition is what is a "profitable" increase? The average annual rate of value growth per d.b.h. class was used as a measure in this study. Increase in value depends primarily upon the rate of volume growth of individual trees and secondly on the quality of the material produced. Data on the growth of trees under management are still lacking so it is necessary to base predictions on information from unmanaged stands. Good management would undoubtedly raise the rate of growth, so the results shown here are conservative.

Using average rates of diameter growth per d.b.h. class, the author calculated the tree diameters, volumes, and conversion returns 10 years in the future. Future conversion returns were determined by estimating the d.b.h. 10 years in the future and determining the corresponding conversion returns for these larger diameters. Tables 7 and 8 show the average annual rates of conversion returns increases if trees are used for three products.

Average annual increase in saw timber value of trees with the highest log grades possible exceeds 10 percent up to 15 inches d.b.h. class, and does not fall below 6 percent until the 21-inch class.

Trees 16 inches d.b.h. and over can have a butt veneer log. The rate of increase for these trees is less than if the entire tree is used for saw timber but the net return is greater. Under present conditions this fact makes it more profitable to cut any tree containing a veneer log. because present returns of the smallest veneer log tree exceed future returns of larger sawlog trees and the rate of increase if used for veneer is low.

The average annual increase in pulpwood values is about 22 percent at 9 inches d.b.h. It then drops rapidly to less than 5 percent at 13 inches d.b.h. after which the rate of decrease levels off.

It is a matter of judgment what a forest manager will take as the rate of increase necessary for a tree to be assumed to be growing profitably and therefore left uncut. The net value of a tree increases with size but its rate of increase necessarily diminishes because the base upon which it is measured is constantly expanding. If a 5 percent rate of interest is desired, the average saw log tree cannot be left beyond 20 inches if it is top quality, or 17 inches if poor quality. Trees growing faster than average justify being left to attain larger sizes. Trees for pulpwood cannot be left much over 12 inches if a 5 percent rate of interest is desired. Purely from a rate of value increase standpoint a tree with a veneer log cannot earn a 5 percent rate over 16 inches d.b.h. and should be cut.

The calculations shown here consider only the individual value of trees as they would be considered at the time of a partial cutting. Black cherry must be handled by some form of even-aged management (*4*). This means that at the time of the regeneration cutting the entire overstory will be removed. At this time the individual rates of growth do not influence the decision as to which tree to cut and which to leave. All trees will be removed regardless of rate of growth.

These calculations are designed only to show the average rates of value increase for trees of different sizes. They should be of assistance in deciding which trees should be cut at the time a thinning or other type of partial cutting is deemed necessary.

In short, these tables show that removal of high value, fast growing trees in a thinning is a waste of a high-yielding investment. Similarly, allowing a tree to remain standing after its rate of return has diminished is a loss of earnings.

Poor quality trees of low value, although growing rapidly in volume, increase little in value. They should be cut to allow the space they occupy to be utilized by better-quality trees, insofar as removal does not interfere with anv usefulness of the tree. Low-quality trees can be left if they are serving a purpose as trainers or pruners, or if their removal would be deleterious to the site.

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Distribution Series Arising in Quadrat Sampling of Reproduction[1]

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REGENERATION SURVEYS of cut-over timberland are commonly conducted using either the stocked-quadrat or the list-quadrat method (*1*). Whereas the relatively inexpensive stocked-quadrat method usually provides information adequate for the purpose of forest management, the more detailed information provided by the list method makes possible an analysis of the distributional pattern of number of seedlings per quadrat.

If the total number of established seedlings on each quadrat is counted, as in the list method, it is possible to determine the number of quadrats containing 0, 1, 2, etc., seedlings. The distribution series which these numbers of quadrats follow will depend upon the density of stocking and whether the seedlings are randomly distributed or tend to occur in clumps.

The Poisson Series

The Poisson series arises with random sampling of a randomly distributed population when the probability of an event is exceedingly small and when a sufficiently large number of independent observations are taken to obtain a number of occurrences. Prerequisites of the Poisson series are thus a low population density or stocking percent and random distribution of individuals. Blackman (*4*), using 6- by six-inch quadrats, found that the distribution of most species tested in certain grassland associations followed the Poisson series. Quenouille (*7*), describing the interrelationship of the logarithmic, Poisson, and negative binominal series, states that the Poisson distribution usually arises in sampling homogeneous material, i.e., when the mean, m, may be assumed to be constant. A simple test of agreement with the Poisson distribution is that the variance should equal the mean.

The Poisson distribution has one parameter, m, which is estimated by the observed mean. In a total of N trials the expected frequency of any positive count, r, is $\phi_r = N.e.^{-m}\frac{m^r}{r!}$, where $e = 2.71828$.

The Negative Binominal Series

In sampling heterogeneous material, however, the mean may no longer be considered fixed for all samples, and Fisher (*6*) assumed that it was distributed as a Gamma-type variable and derived the negative binominal, with two parameters, the mean m and the exponent k. From Anscombe (*2*), the expected frequency of zeros in decimal form is

(1) $\phi_o = N\left(1+\frac{m}{k}\right)^{-k}$, where N is the total number of observations, and the expected frequency of any positive count, r, is

(2) $\phi_r = \phi_o\left(\frac{k+r-1}{r}\right)\left(\frac{m}{m+k}\right)^r$

In order to calculate the expected frequencies so that they may be compared with those of an observed distribution, it is first necessary to estimate the parameters m and k. m is estimated by y, the mean of the observed distribution. k is more difficult to determine, but may be estimated in the following ways.

Method 1.—The most obvious method is to solve for k, the only unknown in equation (1) above if we substitute for ϕ_o the observed number of misses, f_o, and for m the observed mean, y. Then the equation, in more convenient form, becomes $N/f_o = \left(1+\frac{m}{k}\right)^k$, or $\log N - \log f_o = k\log\left(1+\frac{m}{k}\right)$. The left-hand side is a constant which need be calculated only once; the right-hand side must then be equated to this by the method of successive approximations. For example, let $k = 0.1$, 1, and 10, respectively, evaluate the right-hand side for each, then interpolate for the unknown value of the left-hand side between these values in order to obtain a closer approximation of k. This process must be repeated until the estimate k has the required precision. Bliss and Fisher (*5*), state that this method estimates k with an efficiency of 90 percent or more provided that $(m+0.17)(f_o/N - 0.32) < 0.20$. It provides reasonably accurate estimates of k if m does not exceed 1. The efficiency of both this and the method to follow are illustrated graphically by Anscombe (*3*).

Method 2.—A more convenient but not necessarily more efficient method, given by Fisher (*6*) and Anscombe (*3*), makes use of the first and second moments. k is estimated from the sample mean, y, and variance, s^2, using the relationship: $k = y^2/(s^2 - y)$. This method has the advantage of considering the entire distribution, the variance as well as the mean. Bliss states that it provides an estimate of k of not less than 90 percent efficiency if $(k+m)(k+2) \geq 15$.

Method 3.—The only method which provides an estimate of k with 100 percent efficiency is the maximum likelihood solution of Fisher (*6*). In a recent paper in *Biometrics*, Bliss and Fisher (*5*) describe a simplified maximum likelihood solution for k which should bring this accurate method out of the realm of higher mathematics.

Test of Agreement with the Poisson Distribution

Data collected by the author in 1951 on lands of the Crossett Lumber Company, Crossett, Ark., illustrate the comparison of the occur-

[1]Adapted from a paper submitted to Dr. Walter H. Meyer in partial fulfilment of the requirements for the degree of Master of Forestry, School of Forestry, Yale University, May 1951.

rence of loblolly pine seedlings on mil-acre quadrats with the Poisson distribution. It was stated above that the Poisson series is more likely to arise in quadrat sampling if the stocking is sparse. Upon the assumption that the observed series are additive, three tallies, each with an average stocking of 17.5 percent, and each comprising 40 1-milacre quadrats, have been combined to form the distribution given in Table 1.

The observed mean number of seedlings per quadrat is

$$\bar{y} = \frac{S(fy)}{S(f)} = \frac{74}{120} = 0.616,$$

where f is the observed number of quadrats containing y seedlings. The expected number of quadrats containing 0, 1, 2, etc., seedlings, ϕ_0, ϕ_1, ϕ_2, etc., are calculated below. These expected frequencies, summed and subtracted from 120, leave a residual expectation of 2.97 for ϕ_7.[2] The difference between each observed frequency and the corresponding expected frequency, squared and divided by the expected value, leads to an estimate of Chi-squared:

$$\chi^2 = S\frac{(f-\phi)^2}{\phi} = 74.63.$$

TABLE 1.—A TEST OF AGREEMENT WITH THE POISSON SERIES

No. of seedlings per quadrat, y	Observed no. of qupadrats, f	Expected No. of quadrats, ϕ	$f-\phi$	$\frac{(f-\phi)^2}{\phi}$
0	99	64.81	+ 34.19	18.04
1	5	39.92	− 34.92	30.55
2	5	12.30	− 7.30	4.33
3	3	.....	.....	.....
4	4	.....	.....	.....
5	1	.....	.....	.....
6	..	.....	.....	.....
7	..	2.97	+ 8.03	21.71
8	1	.....	.....	.....
9	..	.....	.....	.....
10	1	.....	.....	.....
11	1	.....	.....	.....
Sum	120	120.00	0.00	74.63

Method 1.

$$\text{Log } N - \log f_o = k \log\left(1 + \frac{m}{k}\right), \text{ where } m = 0.616.$$

$$\text{The left-hand side} = \log 120 - \log 99 = 0.083546.$$

(i) Let $k = 1$, then the right-hand side (R.H.S.) $= \log(1 + 0.616) = 0.208441$.

(ii) If $k = 0.1$, R.H.S. $= 0.1 \log\left(1 + \frac{0.616}{0.1}\right) = 0.0854913$.

(iii) If $k = 0.09$, R.H.S. $= 0.09 \log\left(1 + \frac{0.616}{0.09}\right) = 0.0805084$.

Interpolating between the values for the L.H.S. obtained in trials (ii) and (iii),

$$k_1 = \frac{0.0030376}{0.0049829}(0.01) + 0.09 = 0.096,$$

for which the R.H.S. = 0.083540. With m and k_1 determined, expected frequencies are calculated using the two equations previously given. From equation (1);

$$\phi_0 = 120\left(1 + \frac{0.616}{0.096}\right)^{-0.096} = 99.00.$$

This is a mathematical check of the calculated value of k_1.

$$\phi_0 = 120_e{}^{-0.616} = 64.812.$$

Since $\phi_r = \phi_{r-1}\frac{m}{r}$, $\phi_1 = \phi_0 m = 64.812(0.616) = 39.924$, and

$$\phi_2 = \phi_1 m/2 = 39.924(0.616)^2/2 = 12.297.$$

With n (the number of degrees of freedom, equal to the number of values compared less 2) = 2, the probability of an observed Chi-squared of 74.63 is less than 1 in 1000. Moreover the variance (3.196) does not equal the mean (0.616). The conclusion is reached that the observed distribution does not follow the Poisson.

From equation (2): $\phi_1 = \phi_0 \binom{k+r-1}{1}\left(\frac{m}{m+k}\right)$, where $r = 1$,

$$= \phi_0 \frac{k!}{(k-1)!}\frac{m}{m+k}$$
$$= \phi_0 km/(m+k)$$
$$= 99.00\ (0.096)\ 0.616/0.712$$
$$= 8.22256.^3$$

Test of Agreement with the Negative Binomial Distribution

The observed distribution is now compared with the negative binomial, with k estimated according to the first two methods previously described.

Again:

$$\phi_2 = \phi_0 \binom{k+2-1}{2}\left(\frac{m}{m+k}\right)^2$$

$$= \phi_0 \frac{(k+1)!}{2!\ (k-1)!}\left(\frac{m}{m+k}\right)^2$$

$$= \phi_0 \frac{(k+1)\,k}{2}\left(\frac{m}{m+k}\right)^2.$$

[2] For a Chi-square test of agreement, a minimum expectation of 2 is used here. In this example ϕ_3 (= 2.52) exceeds this limit but ϕ_{4+} (= 0.45) does not, so that ϕ_3 and ϕ_{4+} are combined.

[3] The expected frequencies will later be rounded to two places of decimals. However, in order to avoid carrying forward errors due to rounding, it is necessary to use six significant figures in the calculation of successive frequencies.

Comparing this with the symbolic expression for ϕ_1, a simplified expression for the calculation of successive frequencies is (3):

$$\phi_r = \phi_{r-1} \frac{.k + r - 1.}{r} \cdot \frac{m}{m + k}.$$

Thus

$$\phi_2 = \phi_1 \frac{k + 1.}{2} \cdot \frac{m}{m + k}$$
$$= 8.22256(1.096)0.616/2(0.712)$$
$$= 3.89842.$$
$$\phi_3 = \phi_2 \frac{k + 2.}{3} \cdot \frac{m}{m + k}$$
$$= 3.89842\ (2.096)\ 0.86517/3$$
$$= 2.35646$$
$$\phi_{4+} = N - \phi_0 - \phi_1 - \phi_2 - \phi_3$$
$$= 6.52$$

Observed and expected frequencies are compared in Table 2. An observed Chi-squared of 2.08, with n (the number of values compared less 3) = 2, would be exceeded with a probability of between 0.30 and 0.50 if the distribution were, in fact, a negative binomial distribution.

Method 2.

$$k_2 = \frac{y^2}{s^2 - y}, \text{ where } y = 0.616$$

$$\text{and } s^2 = \frac{S\,(fy^2) - S^2\,(fy)\,/N}{N - 1}$$

$$= \frac{426 - (74)^2/120}{119}$$

$$= 3.196.$$

$$\text{Hence } k_2 = \frac{(0.616)^2}{3.196 - 0.616} = 0.147.$$

$$\phi_0 = N\,(1 + \frac{m}{k})^{-k}$$

$$= 120\,(1 + \frac{0.616}{0.147})^{-0.147}$$

$$= 120\left(\frac{0.147}{0.763}\right)^{0.147}$$

$$= 94.1988.$$

$$\phi_r = \phi_{r-1} \frac{.k + r - 1.}{r} \cdot \frac{m}{m + k}$$

$$= 94.1988\ (0.147)\ 0.807339$$
$$= 11.1794.$$

Similarly $\phi_2 = 5.18$, $\phi_3 = 2.99$, and $\phi_{4+} = 6.45$.

When k is estimated by this method $\chi^2 = 4.04$, with 2 degrees of freedom, and the corresponding probability lies between 0.10 and 0.20. The negative binomial distribution again fits the observed series moderately well, but not as closely as when calculated using k_1. The second method would thus appear to be less efficient in this case. This is verified by Anscombe's graph from which k_1 is shown to have an efficiency of over 98 percent and k_2 an efficiency of less than 50 percent. In this instance only a slight gain in precision in the estimation of k would be gained by using the maximum likelihood solution (Method 3).

k was estimated by Method 1 in this study. Agreement with the negative binomial series, calculated in this manner, is illustrated in Table 3 for selected stocking values ranging from 17.5 to 97.5 percent. Only in the last example (stocking 97.5%, m = 4.85) does the probability lie outside the bounds of expectation, with a 0.05 chance of error. The efficiency of this k-estimate is low, however. If fitted by Method 2, $k_2 = 3.424$, the efficiency of the k-estimate is between 75 and 90 percent, and the probability between .001 and .01 showing only a slight improvement over Method 1. Despite the lack of efficiency in fitting the constant k, the overall Chi-squared value at the bottom of Table 3 shows that there is no significant lack of agreement. If the maximum likelihood solution had been used throughout, even closer agreement would have been obtained.

Conclusions

The conclusion is reached that the occurrence of pine seedlings on mil-acre quadrats, in the forest conditions sampled, follows a negative binomial rather than a Poisson distribution series. Both parameters m and k, tend to increase with density of stocking; the relationships existing between these three variables, however, have yet to be investigated. Under certain circumstances, little accuracy may be lost by fitting a common k to each of a group of series such as those represented in Table 3. This technique and tests of its applicability are described by Bliss and Fisher (5).

Presence of clumpiness, which is indicated by the negative binomial, is not unexpected in quadrat sampling when we consider that the establishment of pine reproduction is subject to certain minimum requirements of light, temperature, moisture, and other factors. In stands such as those sampled, which have been cut selectively with varying degrees of intensity, most of the reproduction is found in irregularly spaced openings in the crown canopy. The seedlings thus tend to be spaced not singly, at random, but in groups of varying sizes, shapes, and densities. When

TABLE 2. A TEST OF AGREEMENT WITH THE NEGATIVE BINOMINAL DISTRIBUTION SERIES:

(i) with the exponent k_1 calculated by the method of successive approximations,

(ii) with the exponent k_2 calculated by the moment method.

No. of seedlings per quadrat, y	Observed no. of quadrats, f	Expected no. of quadrats, using k_1, ϕ_1	$(f-\phi_1)^2/\phi_1$	Expected no. of quadrats, using k_2, ϕ_2	$(f-\phi_2)^2/\phi_2$
0	99	99.00	0.00	94.20	0.24
1	5	8.22	1.26	11.18	3.42
2	5	3.90	0.31	5.18	0.01
3	3	2.36	.17	2.99	.00
4	4				
5	1				
6	0 (8)	6.52	.34	6.45	.37
7	0				
8	1				
9	0				
10	1				
11	1				
Sum	120	120.00	2.08	120.00	4.04

TABLE 3.—AGREEMENT OF OBSERVED FREQUENCIES OF NUMBERS OF SEEDLINGS ON MIL-ACRE QUADRATS WITH THE NEGATIVE BINOMINAL DISTRIBUTION.

Stocking percent	Basis number of quadrats	Computed statistics m	Computed statistics k	Efficiency of k-estimate percent	Number of degrees freedom n	Chi-squared	Probability P
17.5	120	0.62	0.096	E>98	2	2.08	0.40
20.0	80	.35	.265	E>98	2	2.58	.30
50.0	120	1.96	.380	98>E>90	8	3.22	.90
85.0	200	6.76	.875	75>E>50	14	10.45	.70
92.5	40	16.88	.854	75>E>50	7	4.34	.75
97.5	40	8.15	2.60	E<50	10	16.69	.09
97.5	40	4.85	7.00	E<50	7	20.85	.005
	640				50	60.21	0.153

larger areas are opened up and made available for regeneration, such as with clear-cutting or the shelterwood system, there may be more homogeneity in the distribution of the seedlings. The author has found, however, that satisfactory agreement with the negative binomial is shown by coniferous seedlings that are restocking an extensive old burn on the Research Forest of the University of British Columbia.

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THE FRUIT of 13 year's research in the development of high-gum-yielding slash pines was picked by Harry A. Fowells, research specialist in the Washington headquarters of the U. S. Forest Service, during a recent visit to the Lake City, Florida Research Center. Keith W. Dorman (*left*), breeder of the parent trees, and François Mergen (*center*), who discovered the inheritance of gum flow and established this grafted seed orchard, watch with the critical interest of all proud parents. Since 1941 these men and their associates have collected gum from thousands of trees while searching for elusive high yielders. Twelve trees having twice the normal yield finally were found. Then it was necessary to devise and perfect hitherto unknown techniques of breeding, rooting, and grafting southern pines. In time a micro-tapping technique for measuring gum yield in young saplings disclosed the inherited characteristics of gum flow. Then twigs from the best strains were grafted onto planted seedlings for the establishment of a seed orchard. Second generation seedlings from this orchard will receive additional testing before being released to the gum naval stores industry for commercial production.

Bark Thickness as a Factor in Resistance to White Pine Weevil Injury[1]

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ENVIRONMENTAL FACTORS are known to have an important influence on the variation in susceptibility of white pine trees to weevil injury. The more vigorous the tree relative to its neighbors, the more susceptible it is to weeviling. Both heredity and external factors have an influence on this relationship. The question arises: Is there resistance, in the sense of inherited variation, which can be related to factors which are not expressions of vigor? Selection of slow-growing intermediates as crop trees may have advantages for the owner of a badly weeviled plantation, but for tree-genetics research negative selection for vigor would be undesirable. Moreover, the weevil is quite capable of attacking slow-growing trees. If variation in severity of weevil injury can be correlated with a factor other than vigor, under fairly uniform environmental conditions, this relationship can be used as a basis for the selection of weevil-resistant trees. The forest manager, too, has a better basis for selecting the potentially straight or nearly straight trees. These can then be pruned at an early age with less risk of future injury by the weevil.

Thus a tree character must not only be correlated with variation in susceptibility; it must also show this variation independent of the age of the tree or its degree of dominance with respect to adjacent trees. Measures such as height and diameter are of little value even if isolated statistically from environmental influences, because of their relation to tree vigor.

In this study, bark thickness at breast height was chosen and its variation as related to susceptibility measured by the number of weevilings per tree. As far as possible, the extraneous effects just mentioned were eliminated. Bark thickness was selected because of the importance of phloem tissue in the biological relationships between the insect and the tree. Extensive investigations by Graham (*1*), MacAloney (*3*), and others have demonstrated that an ample supply of phloem and resin are of primary importance for attraction, oviposition, and larval development of the weevil. The adult weevil shows a definite preference for the most vigorous leaders, and this is considered to be due to the greater amount of resin, and consequently the stronger odor. The vigorous leaders have a thick, succulent bark, and numerous lenticels for the escape of the odor (*3*). Thus there is more weeviling among the dominant and codominant trees than among those in the lower crown classes. The weevil selects the best from what is available. Consequently, the unattractive trees on a good site may be comparable in growth rate to the preferred trees on a poor site.

Although vigor is relative, evidently there are certain absolute minimum requirements which a terminal shoot must supply if it is to be successfully weeviled. This was apparent in earlier studies made by the writer in which a pair of weevils was caged on each of 48 seedlings and grafted trees as a test of variation in resistance to weevil injury. It was expected that many of these leaders would be severely damaged and killed by this forced attack. However, few eggs were laid in the tips and some were not attacked at all. No eggs were laid in shoots 3 mm. in diameter, and an average of 2, 8, and 10 in 4, 5, and 6 mm. shoots, respectively. The bark on these slender shoots is exceedingly thin, and although sometimes feeding cavities could be found on careful examination, the shallowness of these cavities, compared to those in thicker shoots, was quite apparent under the binocular microscope. The few larvae developing in terminals with thin bark were much smaller than larvae of the same age in vigorous terminals with an ample supply of phloem tissue. Mature trees were also found to have a wide variation in tip diameter. In one case, cuttings from the top of an unweeviled 30-year old tree averaged only 2 mm. in diameter. The performance of grafts from this tree will give an indication of the value of slender terminal shoots for studies of resistance (*2*).

The purpose of the investigation reported in this paper was to determine the significance of bark thickness in relation to susceptibility to weeviling, to learn whether or not it provides a better basis for selecting inherently weevil-resistant trees than the measurement of diameter breast high. It was recognized that variations in bark thickness would probably be comparatively small with the effect of diameter eliminated, but it was considered quite possible that these small differences might be significant.

Although bark thickness of the terminal shoot appears to be the critical factor, it is considerably easier to obtain measurements of the bark at breast height. In addition, it is easier to observe variations, since the bark is thicker. Measurement at breast height, being cumulative over practically the entire period of exposure to weeviling, should provide a better guide to conditions during this period than a measurement of current bark thickness. It was anticipated that differences in bark thickness among trees would be characteristic of the entire tree, providing an average of two or three measurements was obtained, and that a significant relationship might be discovered by taking the measurements at breast height. Finally, if such a character is to be usable as a basis for field selections of fairly large trees, it

[1]This paper was written as a special problem while the author was doing graduate study at the Yale School of Forestry. The author acknowledges the advice and assistance of Dr. H. J. Lutz, of the Yale School of Forestry, and of Dr. C. I. Bliss and Miss Margaret Robertson, both of the Yale Statistical Laboratory.

must be readily obtained in the course of stand surveys.

Method

Five pure, even-aged stands of white pine were selected for examination ranging in age from 18 years (Stand A) to 39 years (Stand E). Four of the stands were located in the White Memorial Foundation Forest, in Litchfield, Conn., in the northwestern part of the state. The fifth stand was in the Eli Whitney Forest in North Branford, Conn., near New Haven. The stands were sampled by taking approximately 70 dominant and codominant trees as they occurred along lines laid out to give representative coverage. Sampling was restricted to the upper two crown classes in order to eliminate, as far as possible, the effect of stand structure on weeviling. A few "border-line" intermediates were taken which had been dominants until a few years previously. The d.b.h. of each tree was measured with a diameter tape to the nearest tenth of an inch. Bark thickness was obtained at breast height to the nearest half-millimeter, by averaging two or more measurements taken on different sides of the tree with a Swedish bark gauge. Crown class was tallied, and the number of times weeviled was recorded after a careful study of the tree from all sides.

After preliminary statistical tests of normality, each stand was analyzed separately by partial regression, in order to isolate the effect of bark thickness from the effect of diameter. This analysis provided answers to the following questions: (1) Is the number of weevilings significantly related to either bark thickness at breast height or d.b.h.? (2) If so, does bark thickness provide a better measure of susceptibility than d.b.h.? (3) If bark thickness is important, how much correlated variation is lost by intentionally omitting d.b.h. because of its sensitivity to environmental influences?

Results

Analysis showed that the number of weevilings per tree was partly dependent on bark thickness and d.b.h. These factors together accounted for about one fifth of the variation in susceptibility of trees in the four older stands, and about one third in the youngest stand. There were significant differences between stands in the severity of weevil injury, due to age and undetermined factors.

In three of the stands, d.b.h. had a distinct linear relationship to susceptibility. The smaller the diameter of a dominant or codominant tree, the fewer times it was weeviled. In the other two stands, Stands D and E, diameter did not have a close relationship to susceptibility. In these stands there was a considerable amount of additional variation due to bark thickness, which measurement of d.b.h. alone would not detect. Tihs is shown in statistical terms in the right-hand side of Table 1.

The relationship between bark thickness at breast height and frequency of weeviling was linear and highly significant in all five stands. As a rule, the thinner the bark, the less frequently had the tree been attacked. Table 1 gives the results of regression analyses. Only in Stand C is appreciable improvement obtained in the regression by including d.b.h. as a measured variable. An overall partial regression showed that the number of weevilings per dominant or codominant tree of a given bark thickness varied significantly between different stands except Stands B and E. The decrease in frequency of weevil attack per unit decrease in bark thickness (slope of the regression line) was the same in all but the youngest stand. More specifically, in any one of the stands 25 to 39 years old, if Tree X had a bark 4 millimeters thinner than Tree Y at breast height, Tree X had, on the average, one crook less in it than Tree Y. If the difference were 8 millimeters, Tree X had, on the average, two crooks less than Tree Y.

Most of the unweeviled trees had a bark thickness below the mean for any given diameter. The curve in Figure 1 shows the relationship between bark thickness and d.b.h. for all five stands, and the position of each of the 45 unweeviled trees relative to the curve. The number of unweeviled trees below the curve is significantly greater than the number above the curve.

Although Stands B, C, and E originated as plantations, analysis of the data showed that it was not possible to associate the stand differences shown in Table 1 with either age or stand origin. Site differences did not seem to offer an explanation of results obtained. Stands B and E were the best sites, Stand C the poorest, the others intermediate.

Discussion

Of the two variables, bark thickness provided a better measure of susceptibility than diameter, taking all stands into consideration. The reasons for differences between stands in the relative importance of

TABLE 1.—COMPARATIVE EFFICIENCY OF ESTIMATING SUSCEPTIBILITY TO WEEVIL DAMAGE BY MEASURING (1) BARK THICKNESS ALONE; (2) D.B.H. ALONE.

	(1) Bark thickness (Sum of squares[1])			(2) Diameter breast high (Sum of squares)	
Stand	Total sum of squares, number of weevilings	Regression of number of weevilings on bark thickness, d.b.h. eliminated	Additional regression due to d.b.h.	Regression of number of weevilings on d.b.h., bark thickness eliminated	Additional regression due to bark thickness
A	91.164	27.441***	3.944*	27.626***	3.759*
B	177.855	22.680***	4.746	22.684***	4.742
C	203.939	38.149***	20.479**	58.615***	0.013
D	131.943	18.539**	0.013	7.979*	10.573*
E	273.403	53.621***	0.107	31.320**	22.408*

[1]Significance levels:
Nonsignificant if no asterisk follows number.
*Significant at the 5 percent level.
**Significant at the 1 percent level.
***Significant at the 0.1 percent level.

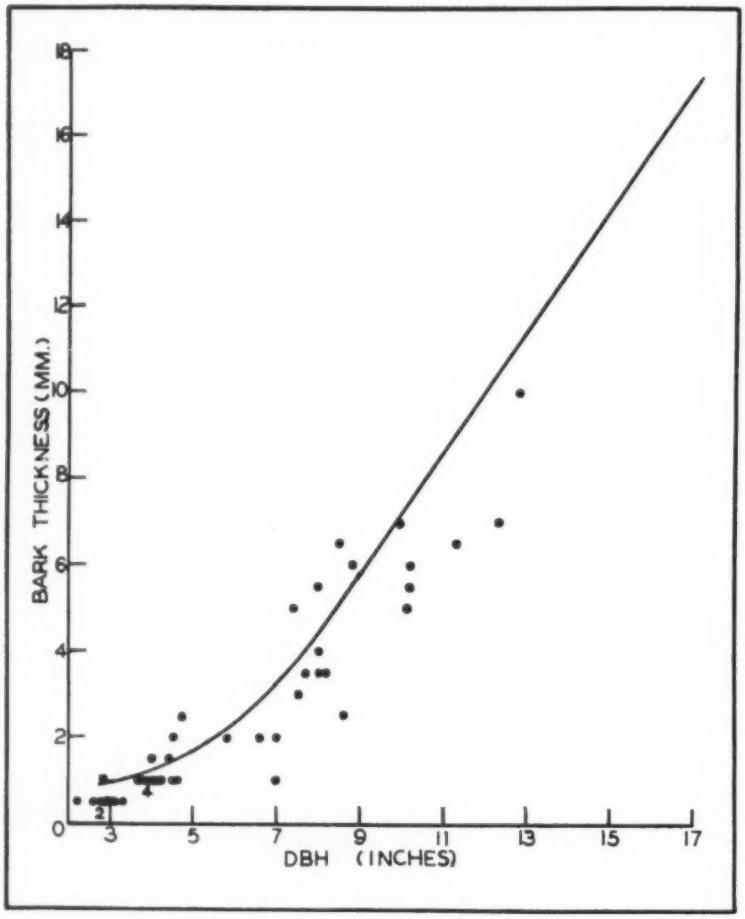

FIG. 1.—The bark thickness of the 45 unweeviled trees, represented by dots, in relation to the curve of bark thickness on d.b.h. for all 353 dominant and codominant trees. A significantly large proportion of unweeviled trees lies below the curve.

diameter and bark thickness and d.b.h. are not clear, but seem to be related to the degree of uniformity of stand structure and density. In stands fairly uniform with respect to density and crown canopy, bark thickness was the more critical factor. In one stand, which had a more irregular structure, diameter was the better measure, although bark thickness still provided a fairly good criterion of susceptibility. This more consistent relationship of bark thickness to susceptibility under several different environmental situations suggests that it is controlled to some extent by genetic factors.

The results show that variation in susceptibility is not purely random, nor is it merely dependent on dominance or relative vigor as expressed by differences in height or diameter. It is also correlated with relatively small differences in bark thickness at breast height among trees of the same diameter and age. This relationship is statistically significant, and is believed to be the accumulated effect of much smaller differences in the thickness of the phloem tissue of the terminal shoot. In some cases these very small differences, possibly hereditary, may be just enough to prevent the larvae of the white pine weevil from developing in sufficient numbers to girdle the shoot. Since most trees are weeviled at least once, the important effect in the majority of the trees is probably the greater attraction of the adult weevils to a thicker phloem, due to the stronger odor accompanying a larger volume of resin.

It should be kept in mind that bark thickness accounted for only a part of the variation in susceptibility. It is only one contributing factor, and cannot be applied to predict exactly how many times a certain tree will be weeviled. Nevertheless it provides an improved basis for tree selection. In young stands the measurement of bark thickness at breast height should be of assistance in the selection of trees for pruning. Although few absolutely unweeviled trees can be expected from pure even-aged stands, a tree with only one crook, or even two, is preferable to one severely weeviled. From a technical standpoint, boards from weeviled logs are undesirable, even if the trees have shown good recovery and the logs are straight, because of the formation of compression wood (Spurr and Friend, *4*). When a considerable number of trees is being selected throughout a stand, the chances of favoring trees of the lowest risk should be greatly improved by choosing the ones with the thinnest bark in a given crown class and diameter class.

Figure 1 indicates that the probability of finding a resistant genotype for tree-breeding purposes will be increased by narrowing the selections down to trees with unusually thin bark. These trees should be absolutely unweeviled, dominant, and in older, heavily-weeviled plantations. Trees that will meet these conditions are comparatively rare, but there is little chance that they were accidentally missed by the weevil. Progeny tests will give the final answer. In the meantime these potentially valuable trees should be reserved from cutting.

Summary

Five pure, even-aged stands of eastern white pine were examined in a study of the relationship between bark thickness and susceptibility to white pine weevil injury. The number of weevil injuries per tree was taken as the measure of susceptibility.

In all stands bark thickness at breast height was found to be sig-

nificantly related to susceptibility to weevil injury, more so than d.b.h. Trees with thin bark were less susceptible than trees with thick bark, although there was considerable variation due to other unknown factors.

Bark thickness is considered to be important because of the relation of the thickness of phloem in the terminal shoot to weevil attraction, oviposition, and larval development. Bark thickness at breast height is a cumulative measure of annual phloem production over the period of exposure of the tree to weevil injury.

In even-aged stands, among trees of equal diameter and height, those with the thinnest bark may be expected to be least injured by the white pine weevil. In forest genetics research, this may be used as a guide in the selection of trees to be tested for inherited resistance to weevil injury.

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Lightning Fire Research in the Rocky Mountains

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LIGHTNING is the major cause of fires in Rocky Mountain forests. The lightning fire problem is the prime target of a broad research program now known as Project Skyfire.

The aims of Project Skyfire are broad in character. First, it hopes to gain a better understanding of the occurrence, behavior, and control of lightning fires. Eventually, after fundamental studies provide necessary background, Skyfire expects to test the possibility of preventing or reducing the severity of lightning fires through cloud-modification operations.

Accomplishment of these aims is expected to be achieved through a cooperative research program which capitalizes on the special talents and facilities of a score of private, state, and federal agencies. Skyfire has been initiated as a cooperative enterprise of the Intermountain Forest and Range Experiment Station and the Munitalp Foundation, a private research organization dedicated to the advancement of basic studies of meteorology. Also assisting in the project are Region 1 of the U. S. Forest Service, the National Park Service, the U. S. Weather Bureau, and the General Electric Research Laboratory. Future assistance is anticipated from other forest protection organizations and several colleges and universities.

An active field program is underway on two of the six research tasks now charted for Project Skyfire. During the 1953 fire season a cloud survey was initiated in the northern Rocky Mountains. Throughout each day of the fire season observers at 25 national forest fire lookout stations have been reporting on the development, movement, and action of clouds associated with lightning storms.

A second major task now underway is observation and analysis of the jet stream—a zone of globe-circling winds in the substratosphere which may be related to lightning occurrence and fire weather patterns. Attempts are being made to map the jet stream through observation of certain cirrus and altocumulus clouds often associated with this river of high-velocity air. In both the jet stream study and the cloud survey, time-lapse motion-picture cameras are being used to record the action of clouds.

Future research tasks will include analysis of fire-weather records obtained from some 150 fire danger rating stations, study of a cloud-breeding area to gain a better understanding of the origin and action of lightning in mountainous country, and atmospheric research where a mobile field laboratory will be used to explore the relationship of such factors as incoming and outgoing radiation, soil and air moisture, and atmospheric nuclei and electricity to lightning and fire behavior. Finally, after these tasks have provided a foundation of basic knowledge, field tests will be made of methods for preventing or reducing the severity of lightning fires.

The Lightning Fire Problem

The reasons for a research undertaking of the scope of Project Skyfire are written across vast burned areas in the 120 million acres of Rocky Mountain forests requiring protection from lightning fires. During the 5-year period 1948—1952 over 17,000 lightning fires occurred in the ten Rocky Mountain states. The average annual load of 3,500 lightning fires amounts to 63 percent of the total number of fires occurring in the rugged mountain country ranging northward from Arizona and New Mexico through Idaho and Montana.

In the 40 odd years of organized forest protection in the Rocky Mountains many advancements

have been made in lightning fire control. Fire danger rating systems originated here. Fire weather forecasting, better transportation to back-country areas, improvements in fire equipment, and systematic fire control planning have all contributed to more effective protection. More recently the smokejumper program and widespread use of aircraft are spectacular examples of continued progress.

The increasing demands upon the forest resources of this region point to the need for still greater assurance that lightning fire control will be generally effective. The very nature of widespread dry lightning storms over rugged forested country indicates the great potential for conflagrations. Since the three-million-acre burn of 1910 in the northern Rockies, it has been evident that superbly organized and executed fire control programs are essential[1]. No less an effort can assure the safety of the region's resources or the lives and property of its people.

Foresters who have engaged in lightning fire control programs recognize that many of the advancements made to date have been the obvious things to do. To a large degree the cream has been skimmed and in the future, needed progress will be more difficult. The road ahead depends heavily upon research progress in still unsolved lightning fire problems.

Lightning fires have certain characteristics indicating requirements for successful fire fighting and focussing attention on research priorities. One of the most important of these characteristics is the tendency for a great number of lightning fires to occur in a short period. Northern Rocky Mountain forests have been seized by some 400 lightning fires in 24 hours and over 1,500 in ten days. Over a span of 15 fire seasons there have been 76 days when 50 or more lightning fires started in Montana and northern Idaho national forests. Under critical conditions individual forests in the southwest and the northern Rockies have been hit by nearly 200 fires from a single storm.

The bunching of a large number of fires in a short period places great stress on fire-control forces. Economic factors prevent the design of fire-control organizations that are constantly mobilized to meet these overloads. Economical and effective fire control in lightning country calls for great flexibility to rapidly expand or contract detection and suppression forces and great mobility to move these forces to zones of intensive activity. These principles of lightning fire control have long been recognized. However, their full application requires knowledge of when and where lightning fires may start, how many may start, how they will behave once started, and what factors will influence ease or difficulty of control. Project Skyfire is directed at these basic questions and in addition will investigate methods for reducing great overloads of lightning fires.

Recent developments point to possibilities of achieving a better understanding of the lightning phenomena and of the basic meteorological factors influencing the cause and subsequent behavior of lightning fires. Advances in the science of meteorology are providing new information on cloud formations, cloud physics, atmospheric nuclei, and air movements. Meteorologists have only recently begun intensive study of the jet stream and of the relation of this zone of high-velocity air to weather conditions. Of special significance with respect to possible lightning prevention is the recent work of Langmuir, Schaefer, and others of the Project Cirrus group in weather modification and treatment of cumulus clouds[2].

Cloud Survey

The first major field activity of Project Skyfire has been a cloud survey designed to find out when and where cumulus clouds form and to chart their life cycle from initial formation to the lightning stage. A special objective is to identify cloud-breeding areas where more detailed studies can be made of lightning and lightning fires.

The cloud survey being made in the Northern Rocky Mountains utilizes existing facilities at forest fire lookout stations to obtain data for research purposes. Prior to the 1953 fire season, lookout-firemen from the 25 stations in the observation network attended a special training school to receive instruction in cloud identification and general survey techniques. Each day during the fire season a special form filled out at cloud-survey stations recorded the story of clouds and lightning. In addition, during especially interesting days a brief flash report transmitted by radio from each survey station enabled the Project Skyfire staff to obtain a quick picture of cloud action and potential lightning danger over an area of 30 million acres.

The Project Skyfire cloud survey is in a pioneer stage, but already there are indications of its value. Clouds are dynamic indicators of weather and lightning conditions. Results to date show that it is feasible to chart the action of clouds and lightning from fire lookout stations. The information thus obtained provides research workers with a new tool for exploring the lightning fire phenomenon. Furthermore, it is being demonstrated that a network of cloud-survey stations can provide fire-control organizations with useful information for advance location of fire occurrence zones, dispatching fire fighters and evaluating probable fire behavior.

Jet Stream Study

A second major activity of Project Skyfire is study of the jet stream. The great high-altitude winds now known commonly as the jet stream may be visualized as a river of air flowing around the world on a meandering course from west to east and varying in width

[1]Barrows, J. S. Forest fires in the Northern Rocky Mountains. Northern Rocky Mountain Forest & Range Experiment Station Paper No. 28, 251 pp., illus. 1951.

[2]Schaefer, Vincent J. Final report Project Cirrus, Part I, Laboratory, Field, and Flight Experiments. General Electric Research Laboratory Report No. RL-785. 170 pp., illus. 1953.

from ten miles to several hundred. The altitude of the main axis of the jet stream may vary from 20,000 to 40,000 feet. During the fire season months, two or more jet streams may be present over the western United States and Canada, although from meager information now available it appears that the usual pattern is for only one particular path of air to form the true main axis.

While specific knowledge of the jet stream is still very limited, indications are that these great winds may be closely related to many lightning and fire behavior factors. Under some jet-stream conditions lightning may possibly be prevented or reduced by wind action shearing off the tops of towering cumulus clouds. Under other jet stream conditions the lightning storm may possibly become more severe. Of great interest to foresters is the apparent relationship between the jet stream and periods of extremely dry and windy weather. There are strong possibilities that knowledge of the jet stream may answer some of the major problems of predicting fire behavior in Rocky Mountain forests.

Observations made by Schaefer show that certain cloud types are often associated with the jet stream.[3] This association between cloud formations and high-altitude winds points to the exciting possibility of observing and mapping the jet stream by visual methods. In turn, foresters may find that jet-stream clouds serve as indicators of fire weather and lightning conditions and signal some of the probable patterns of fire behavior.

Cloud forms of the jet stream appear to be of four types. The two high cloud types are long streamers of cirrus moving at high velocity and great patches of cirrocumulus made up of cells showing small waves and ripples. The middle cloud types are the altocumulus lenticular tapered like a lens, and often layered in the sky like a stack of leaning flapjacks, and altocumulus billows appearing as parallel bands of clouds showing waves or billows at right angles to their motion.

As an additional phase of the cloud survey, the 25 fire lookouts have been recording daily observations of jet stream clouds. This information will provide the basis for making generalized jet-stream maps which in turn will be compared with the daily high-altitude wind maps furnished by the Weather Bureau. The jet stream is also being studied in relation to lightning occurrence, wind velocity at ground level, air and fuel moisture, and burning index.

Time-lapse Photography

As an important part of both the cloud survey and the jet-stream study, time-lapse motion-picture cameras are being used to record cloud phenomena. The time-lapse motion-picture camera enables cloud action, which is difficult to appreciate with the naked eye, to be speeded up and witnessed as a spectacular series of events. The special cameras provided by the Munitalp Foundation enable an hour of cloud action to be compressed into two minutes of film time. A battery-operated electric solenoid automatically opens the camera shutter every two seconds.

During the summers of 1952 and 1953 over 5,000 feet of time-lapse color motion-picture film has been exposed at fire lookout stations in Rocky Mountain national forests and parks. These motion pictures provide a useful means for studying cloud, lightning, and jet stream activity. This program is expected to provide a film library documenting significant events in Rocky Mountain skies.

Future Studies

The cloud survey and the jet-stream study are the first efforts of Project Skyfire. Additional phases of the planned research program including fire weather analyses, atmospheric research, and study of a cloud-breeding area will be initiated as soon as the necessary facilities and research staff become available. Each of these research tasks should yield segments of the fundamental knowledge needed before work begins on the ultimate goal of attempting to answer the key question—can lightning fires be prevented?

The possibility that lightning fires may be prevented or reduced in severity stems from the pioneer work of Langmuir and Schaefer and from the operational experiences of many others in the cloud-seeding field. It has been demonstrated in the laboratory and the natural atmosphere that cumulus cloud structures may be modified through the introduction of such nuclei as dry ice and silver iodide. These demonstrations point to the desirability of testing cloud modification as a means of reducing lightning occurrence. Experience in experimental meteorology indicates that it may be possible to overseed mature storms in an effort to eliminate the super-cooled clouds associated with lightning, or to initiate the precipitation cycle in growing clouds before they become large enough to produce lightning.

The exact course of events and the results of the research of Project Skyfire remain largely unknown. Recent advances in meteorology and forestry, and the continuing problem of lightning fires make this program a timely undertaking. The possibilities for lightning prevention are worthy of full investigation. Whatever may be the results of these tests, it appears that the very nature of the required research may yield new knowledge of lightning fire occurence, behavior, and control. Future protection of Rocky Mountain forests depends in part on this knowledge.

[3]Schaefer, Vincent J. Cloud forms of the jet stream. Tellus V. Stockholm, Sweden. 1953.

Improved Forage Under Southern Pines

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CAN IMPROVED forage plants and pine trees be produced successfully on the same area? Some maintain that integration is feasible and that fire protection as well as grazing values might be improved by replacing native vegetation with improved forage species. Logical reasoning would suggest that an increase in number and size of trees would be accompanied by a decrease in herbaceous growth beneath them. The extent to which this relationship is true for pine stands in southern Georgia has been studied[1] for four years under different site conditions and fertilizer treatments at two localities; near Cordele in the middle Coastal Plain and near Alapaha in the lower Coastal Plain.

The experimental area was characterized by longleaf (*Pinus palustris*) and slash pine (*P. elliottii*) trees of pole and small sawtimber size. Herbaceous species were primarily pineland threeawn (*Aristida stricta*), Curtiss dropseed (*Sporobolus curtissii*), slender bluestem (*Andropogon tener*), and carpetgrass (*Axonopus affinis*). The two major grasses, pineland threeawn and Curtiss dropseed, can be practically eliminated by continued close grazing after burning. The principal shrubs, gallberry (*Ilex glabra*), southern waxmyrtle (*Myrica cerifera*), and sawpalmetto (*Serenoa repens*), were unpalatable and quite inflammable.

Soil types at the middle Coastal Plain location were well drained Susquehanna sandy loam on the rolling upland, and poorly drained Plummer sand on lowlands along drainageways. The main soil type on the nearly flat lower Coastal Plain location was Lynchburg loamy fine sand, an imperfectly drained soil. All soils were of low fertility.

[1]Forest Service; Bureau of Plant Industry, Soils, and Agricultural Engineering; and Bureau of Animal Industry, all of U. S. Department of Agriculture; and Georgia Coastal Plain Experiment Station, cooperating.

Improved forage species selected for the study were Louisiana white clover (*Trifolium repens*) and Dallisgrass (*Paspalum dilatatum*), which are important pasture species of the region, and carpetgrass a widely adapted naturalized species. These species all have desirable attributes as well as shortcomings as forest range plants.

In addition to fixing nitrogen and being palatable and nutritious, Louisiana white clover produces green and fire-resistant foliage during the winter and spring fire season. Although it behaves in this area as a reseeding annual which dies out in early summer, seed production is usually adequate to perpetuate stands even under close grazing. White clover grows well in combination with grasses, and can be successfully introduced into forest range without tillage (*1, 2, 3*).

Dallisgrass is highly productive in summer when white clover is dormant and makes an excellent companion grass for legumes. It also endures the close grazing necessary to prevent an accumulation of herbage which would become inflammable in late fall and winter. Dallisgrass requires more favorable conditions and is more difficult to establish than some other improved species.

Carpetgrass is palatable, easily established, aggressive, and widely distributed over the Coastal Plain region. Although its nutritive quality is only moderate and its productivity low, carpetgrass may have a place in a forest grazing program because it is cheap to produce and is helpful in retarding woods fires.

Experimental Procedure

A clover and grass mixture was evaluated using six fertilizer combinations on plots 25 feet square under open, medium and dense tree canopies. The canopy-fertilizer combinations were replicated three times each on a well-drained upland site and on a poorly drained lowland site in the middle Coastal Plain, and replicated twice on one site—an imperfectly drained "upland"—in the lower Coastal Plain.

Tree canopies selected as "open," "medium," and "dense," had basal areas (cross-section area at breast height) of 0-20, 21-55, and over 55 square feet per acre, respectively, including all trees within 6 feet of the plots. Average diameter at breast height was approximately 7 inches. Variations within these classes were accounted for through covariance in statistical interpretations of the data.

Fertilizer treatments included a basic fertilization of phosphate (P_2O_5) and potash (K_2O) equivalent to 70 pounds each per acre applied to all plots. Additional phosphate (70 pounds per acre), potash (70 pounds per acre), nitrogen (30 pounds per acre), and minor elements[2] were applied to randomly designated plots. These fertilizations were made prior to seeding in the fall of 1948, and were repeated the next spring at one-half the original rate. In the fall of 1949 and 1950 the plots were refertilized at the initial rate in the lower Coastal Plain location, and at 70 percent of the initial rate in the middle Coastal Plain. Refertilization was similar in 1951 except that nitrogen was omitted. Dolomitic limestone was applied at the rate of one ton per acre to all plots in 1948 only.

After the forest "rough" had been burned off and lime and fertilizer applied, the white clover was broadcast seeded (4 pounds per acre) on all plots in the fall. At the same time, half the plots in the lower Coastal Plain were seeded to Dallisgrass (10 pounds per acre), and the remaining plots were seeded the following spring. At the middle Coastal Plain one

[2]A mixture of hydrated manganese sulfate, borax ($Na_2B_4O_7 \cdot 10H_2O$), copper sulfate, and zinc sulfate, in a 2-2-1-1 ratio, at the rate of 60 pounds per acre total.

half of each plot was seeded to Dallisgrass and the other half to carpetgrass (3 pounds per acre) in the spring of 1949. No form of mechanical cultivation was employed. Cattle grazed all plots closely from March through September every year.

Forage stands were periodically rated using an arbitrary classification of: 1-2 excellent, 3-4 good, 5-6 fair, 7-8 poor, and 9-10 failure. In addition, yields under the open canopy condition were obtained in 1950 and 1951 by temporarily excluding cattle from two replications at both locations. Chemical analyses indicating forage quality were made of forage samples collected in 1950.

Effect of Tree Canopy on Stands of Improved Forage

Louisiana White Clover

The first spring after establishment, fair to good stands of clover were obtained under all canopy classes. Clover growth extended later in the season and stands were better in the summer under trees than in the open (Fig. 1). Apparently the shade favored this cool-season species during hot weather. The following spring, however, clover stands were inversely related to tree canopy. In the open, clover stands had improved over the first year, while only fair to poor stands remained under the medium and dense canopies, respectively (Fig. 2). This effect of trees on clover stands was similar for both locations. The accumulation of needle cast, which was proportional to tree canopy, was thought to be primarily responsible for thinning the clover stands under trees. Presumably, the accumulated litter reduced the production and/or the germination of clover seed. Existing plants under trees again continued growth longer into the summer than did those in full sunlight.

The relationship between clover and trees during the fourth growing season was similar to the second year except that clover stands tended to be slightly reduced (Fig. 2). Under trees this would be expected on the basis of additional needle cast. In the open, clover stands continued to be good although they declined slightly at the lower Coastal Plain site as a result of increased density of shrubs such as gallberry, waxmyrtle, and sawpalmetto.

Clover stand ratings for 1950 and 1952 from the middle and lower Coastal Plain locations were inversely related (correlation coefficient of —.82) to basal area of trees (Fig. 3). The similarity in slope of the regression lines for middle and lower Coastal Plain conditions indicates that this relationship is consistent for pine trees of the size studied, and of rather broad application in the southern Coastal Plain region—at least for poles and small sawtimber. It appears that without litter removal, good stands of clover may be maintained under tree stands having basal areas up to 15 square feet per acre—approximately 12 percent of "normal" (maximum) stocking for slash pine (5). As tree basal area increases, clover stands decrease and only poor clover stands or complete failures can be expected where tree basal area exceeds 50 square feet per

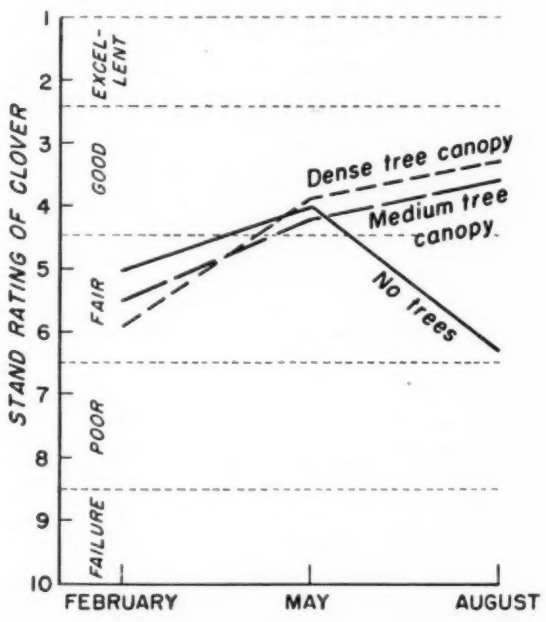

FIG. 1.—Effect of tree canopy on Louisiana white clover stands the first year after planting at middle Coastal Plain location, 1949.

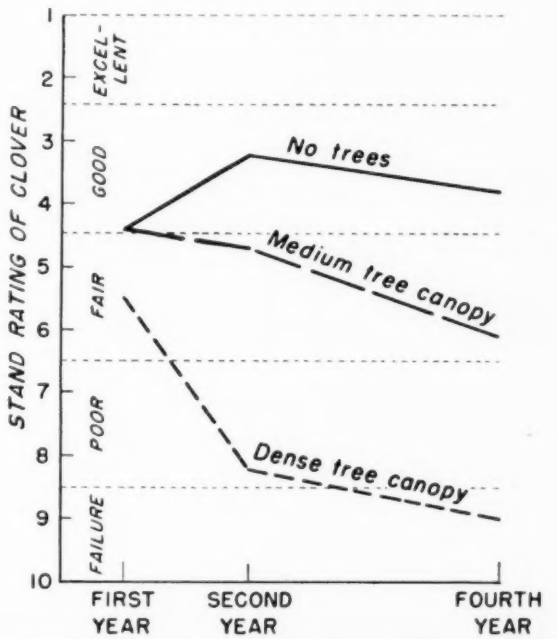

FIG. 2.—Effect of tree canopy on Louisiana white clover for four years following planting. (Average of lower and middle Coastal Plain locations.) Stand ratings made during spring when clover was making maximum growth.

acre, or approximately 35 percent of maximum stocking.

The first year's results of this experiment indicate that it might be possible to grow legumes under fairly dense pine tree canopies if litter and needle cast were removed annually. Periodic removal by burning would be an economical procedure provided tree damage could be avoided. This may be feasible under prescribed conditions (*4*), but it would be necessary for the legume to withstand burning. With white clover, burning would need to be accomplished in the fall when ungerminated seed on the soil can be safely burned over. Winter burning would kill most of the established clover seedlings and may necessitate reseeding.

Carpetgrass and Dallisgrass

Carpetgrass stands improved from year to year but, like clover, were strongly influenced by tree canopies. Being well adapted to most Coastal Plain sites and extremely tolerant of close grazing, carpetgrass spread to plots where it was not seeded. Tree canopy, with accompanying needle cast, and brush competition appeared to be the main deterrents to carpetgrass under the grazing conditions studied. Apparently, only poor stands will persist where tree basal area exceeds 50 square feet per acre. Removal of litter by burning could be expected to favor carpetgrass as well as clover, but this aspect was not investigated.

Seedings of Dallisgrass were generally unsuccessful. Fair to poor stands present in 1950 had declined on all plots by 1952. This appeared to be primarily a result of competition from carpetgrass under close grazing where there were no trees. Where trees were present, stands of Dallisgrass were further reduced even though competition from carpetgrass was less than in the open. More intensive cultural practices than were employed in this study seem to be necessary for dependable establishment and maintenance of Dallisgrass.

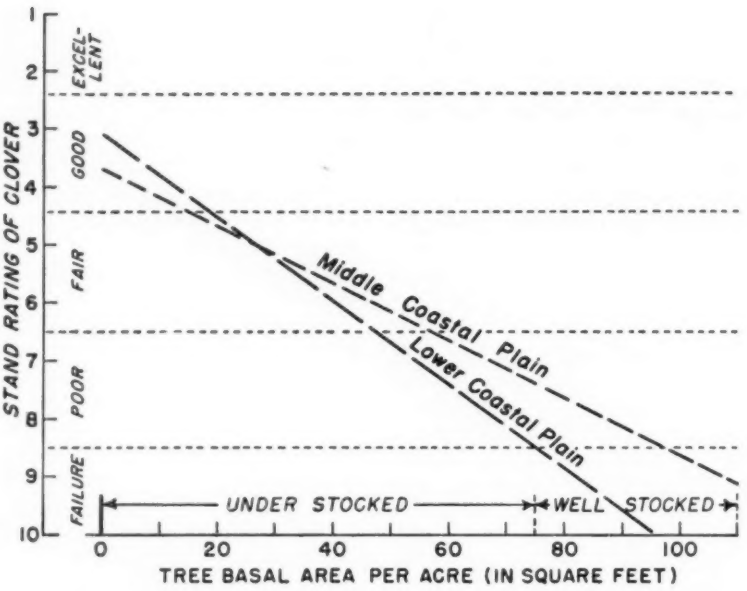

FIG. 3.—Relationship between tree basal area and Louisiana white clover stands. Standard error of estimates are 0.95 and 1.57 for lower and upper Coastal Plain, respectively.

Effect of Fertilizer Rates and Land Sites

In addition to lime, both phosphate and potash fertilization is required for good clover production on the forest soils studied. When these fertilizers were applied together, clover yields tended to be proportional to the rate of fertilization, as shown in Table 1 for the lower Coastal Plain location. Applied separately, additional phosphate or potash was less effective. No significant clover response was obtained from the addition of minor elements (manganese, boron, copper and zinc). These same general responses of clover to fertilization were obtained at both locations and under different tree canopy classes, although yields were somewhat lower at the middle Coastal Plain location. Carpetgrass and Dallisgrass production was increased only slightly at either location by additional fertilizers, indicating that for these grasses the basic fertilization of phosphate and potash was adequate. Grasses did not respond to nitrogen fertilization because application was made in the fall when grasses were relatively dormant. By the time grasses had begun growth the following spring, the greater portion of applied nitrogen had apparently been lost from the soil. The inference is that most of the nitrogen used by the grasses was made available through fixation by the clover.

Land site, or soil type, had a pronounced effect on forage yields. For example, at the middle Coastal Plain during 1951, lowland open areas produced about 780 pounds of clover (oven dry) per acre as compared to 260 pounds on upland open sites. Also, combined production of carpetgrass and Dallisgrass was about 1,000 pounds per acre on lowland but only 500 pounds per acre on upland.

Quality of improved forage plants on the fertilized plots was much superior to burned native forage of the unfertilized forest range. Chemical analysis of samples collected during the spring of the year are shown below (calculated to a moisture-free basis):

	Crude protein	*Calcium*	*Phosphorus*
		Percent	
Louisiana white Clover	25	1.26	0.35
Dallisgrass	15	.46	.30
Carpetgrass	12	.46	.26
Native forage	9	.14	.14

Improved Grasses and Legumes for Fire Control

For the three years tested, good stands of white clover in open areas prevented woods fires from spreading more than a few feet into the sod. This protection was provided from the time clover had produced enough growth to overtop dry grass, generally in January, until it died out in late spring. Because clover did not persist during hot weather, it was not useful for fire protection during the summer and fall.

Observations indicated that closely grazed carpetgrass and Dallisgrass areas provided adequate barriers to fire while they were making growth from early spring until frost. After frost, however, these grasses were not dependable for stopping fires.

Since white clover grows well with carpetgrass and Dallisgrass, a combination of these species provides good protection from late January to early November. For the remaining two or three months some additional protection is needed even though fuel on grazed sods is limited and fire control is relatively easy. Experience has shown that exposing bare soil with a 6-foot disk harrow will effectively stop fire-creep on such sods. Needle cast destroys the effectiveness of disked strips and grass-legume sods for fire protection. Therefore, for maximum protection, as well as forage production, trees should be removed from a firebreak strip.

TABLE 1.—AVERAGE PRODUCTION OF LOUISIANA WHITE CLOVER ON PLOTS WITHOUT TREES AT THE LOWER COASTAL PLAIN LOCATION

Treatment	Pounds of dry matter per acre	
	1950	1951
Basic fertilization[1]	650	1,140
Additional nitrogen (30 lbs. per acre)	560	950
Additional minor elements (60 lbs. of mixture per acre)	690	1,380
Additional phosphate (70 lbs. per acre)	920	1,310
Additional potash (70 lbs. per acre)	960	1,220
Additional phosphate, potash, and minor elements	1,140	2,050
L.S.D. at 5 percent level	300	400

[1]All plots received a basic fertilizer treatment of 70 pounds each of phosphate (P_2O_5) and potash (K_2O) per acre annually, and an initial application of 1 ton of dolomitic limestone per acre.

Conclusion

Improved forage species such as Louisiana white clover, carpetgrass, and Dallisgrass can be established without tillage in longleaf-slash pine forests when litter is removed by burning and fertilizer and lime are applied. Although clover growth extends later into the summer under partial shade, forage stands and productivity decrease proportionately as tree basal area and canopy increase. Best forage production can apparently be obtained without trees. In this study very limited forage production was maintained under well stocked timber stands where tree basal area exceeded 50 square feet per acre. Much of the canopy effect is attributed to needle cast, which suggests that better forage production under trees may be possible through periodic removal of litter.

Good stands of white clover are ordinarily noninflammable from January to May in southern Georgia. Grazed carpetgrass and Dallisgrass sods were effective fire barriers from April to frost. Thus, grazed sods composed of a combination of these species provide yearlong protection except for the November-January period. Freshly exposed strips of bare soil will stop fire-creep during this period when such sods are relatively dormant. For maximum protection, trees should be removed from firebreaks to eliminate needle cast.

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Highlights of a Port-Orford-Cedar Regeneration Study

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How well does Port-Orford-cedar (Chamaecyparis lawsoniana *A. Murr. Parl.*) *regenerate after old-growth stands have been logged? What environmental factors affect its regeneration? These are some of the problems recently studied by the Pacific Northwest Forest and Range Experiment Station. Among other things, the studies showed that Port-Orford-cedar does regenerate successfully after logging, and that seedling establishment is closely related to number and distribution of seed trees.*

NATURAL STANDS of Port-Orford-cedar are found only in the coastal forests of southwestern Oregon and northern California. It rarely forms pure stands of any extent and usually makes up less than 25 percent of the stand. Throughout the northern part of the range its chief associates are Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco), Sitka Spruce (*Picea sitchensis* Bong. Carr.), grand fir (*Abies grandis* Lindl.), western hemlock (*Tsuga heterophylla* Ralf. Sarg.), and western redcedar (*Thuja plicata* Donn). Toward its southern limit Port-Orford-cedar mixes with redwood (*Sequoia sempervirens* D. Don Endl.), California red fir (*Abies magnifica* var. *magnifica*), and on the higher slopes with ponderosa pine (*Pinus ponderosa* Laws.) and sugar pine (*Pinus lambertiana* Dougl.).

Cutting practices have ranged from clearcutting all species to high grading the good cedar and the best of the Douglas-fir. On clearcut areas, the slash has usually been broadcast burned. Partial cuttings have either been left unburned or spot burned.

Methods

Ten clearcut and 10 partial-cut areas were studied in the summer of 1949. Four clearcuttings, located near the coast, had been cut and broadcast burned 33 to 50 years before the study. All 4 were reburned by wildfire during the period 1936-38. The other 6 clearcuttings, located in the mountains, had been cut and the slash burned 7 to 14 years before the study.

The original stand structure on each area was determined by 25 circular quarter-acre plots. To reconstruct the stand, all living trees 7.0 inches or more in d.b.h., stumps, and postlogging snags were recorded by species and size.

Within each stand-structure plot, a 16-mil-acre circular plot was used to sample regeneration. Each regeneration plot was subdivided into 4-mil-acre quadrants. Although the study was concerned primarily with Port-Orford-cedar, stocking data were collected for all species. Reproduction was tallied by species, as advanced (started before logging) or subsequent (started after logging). The following information was recorded for each quadrant: species of the dominant seedling or sapling, number and location of seed trees, slope, aspect, geological formation, soil type, soil depth, soil moisture, seedbed condition, burned or unburned, humus depth, and ground cover.

Seed source or seed-tree effectiveness for each sample plot was evaluated in terms of: (1) number of seed trees, recorded as 1, 2 to 5, 6 to 10, or more than 10; (2) distance in chains to nearest source of Port-Orford-cedar seed; and (3) relative elevation—above, below, or level with sample plot. Using the multiple correlation method of Bruce and Reinecke[1], these three factors were then combined into a single numerical rating. Since the correlation of "seedlings per 16-mil-acre plot" and relative position of seed trees did not prove significant, the final ratings are based solely on the distance and number of seed trees (Table 1).

A summary was then prepared for each study area showing the stocking of Port-Orford-cedar and other species, the dominant species, and whether the reproduction had started before or after logging. Stocking on the four older, reburned clearcut areas was so much less than on recent clearcuttings that three "methods of cutting" or stand treatment were used in the analysis: (1) older, reburned clearcuttings; (2) recent clearcuttings; and (3) partial cuttings.

For the recent clearcuttings, the correlation between number of cedar seedlings and seed trees and other environmental factors was then determined. In these tests, only the seedlings that had started since logging were counted. Preliminary tests showed that two of the clearcuttings belonged to a different statistical population in their relation to seed trees. Conse-

[1]Bruce, Donald, and L. H. Reinecke. Correlation alignment charts in forest research; a method of solving problems in multiple curvilinear correlation. U. S. Dept. Agric. Tech Bul. 210.

TABLE 1.—SEED TREE RATINGS BY DISTANCE FROM SEED SOURCE AND NUMBER OF TREES IN SEED SOURCE

Distance in chains	Rating when number of seed trees was—			
	1	2 - 5	6 - 10	More than 10
0 - 2	9	9	10	10
2 - 4	6	7	8	9
4 - 6	1	3	6	8
6 - 8	1	1	4	7
8 - 10	1	1	3	7
10 - 12	1	1	3	7
12 - 14	1	1	2	6
14 - 16	1	1	1	6
16 - 18	1	1	1	5
18 - 20[1]	1	1	1	4

[1]If distance was more than 20 chains the rating was "0".

TABLE 2.—STOCKING FOR THREE KINDS OF CUT-OVER AREAS[1]

Item	Recent clear cuttings	Older reburned clear cuttings	Partial cuttings
Percent of quadrants[1] stocked, all species	88[2]	53[2]	72[2]
Percent of quadrants containing Port-Orford-cedar	43[3]	25[3]	40[3]
Percent of stocked quadrants dominated by cedar	17	30	26
Percent of stocked quadrants dominated by cedar or Douglas-fir	71	50	58
Percent of stocked quadrants dominated by advanced reproduction	3	0	16

[1]Based on 4-mil-acre quadrants.
[2]Mean stocking for each type of cutting was significantly different from the others by "t" test.
[3]Differences not significant by "t" test.

quently, only data from 96 plots on 4 areas were used in the analyses.

These data were analyzed by multiple correlation, again following the methods of Bruce and Reinecke. Preliminary tests had shown four independent variables most likely to influence seedling numbers: seed trees, slope, aspect, and depth of organic layer. Of these, only seed trees were found to be significant. Residual variation in number of seedlings per plot, after the effects of seed trees had been eliminated, were then tested against the remaining variables for other possible influences.

Effects of Cutting Method

The study shows that clearcutting with only one burning produced the best regeneration of desirable species. For all species combined, stocking on the recent clearcuttings averaged 88 percent, on the partial cuttings 72 percent, and on the older, reburned clearcuttings only 53 percent (Table 2).

All of the recent clearcuttings were uniformly well stocked (70 percent or more). The partial cuttings varied considerably, with seven out of nine in the "well-stocked" category. The older, reburned clearcuttings varied most widely and none could be classed as well stocked.

Effects of cutting methods were not so clearly defined when stocking with Port-Orford-cedar was measured separately. Stocking on the recent clearcuttings and the partial cuttings averaged nearly the same, 43 and 40 percent respectively. This was substantially better than the 25 percent average for the older, reburned clearcuttings. Variations from area to area, however, were so great within treatments that no two of the means were significantly different by "t" test.

The largest seedling on any quadrant is usually in the best position to survive and grow, and is indicative of future composition of the stand. Cedar dominated 17 percent of the stocked quadrants on recent clearcuttings, 26 percent on partial cuttings, and 30 percent on reburned clearcuttings (Table 2). Cedar dominated nearly 15 percent of all quadrants (both stocked and non-stocked) on the recent clearcuttings, 16 percent on the reburned clearcuttings, and 19 percent on the partial cuttings (Fig. 1). Although cedar regenerated most abundantly on the recent clearcuttings, it did not compete as well with the associated species on these areas, especially with Douglas-fir.

The relative site quality and tolerance of species help to explain some of these results. The recent clearcuttings and all partial cuttings were in the mountains where the site index[2] for Douglas-fir is high, averaging 176 for the study areas. In these locations Douglas-fir is an aggressive competitor. But being the most light-loving species in the stands, its aggressiveness is greatest on the recent clearcuttings where it dominated nearly half of all quadrants. On partially cut tracts, Douglas-fir did not compete so well and the more tolerant cedar dominated a higher proportion of the quadrants. All older, reburned clearcuttings were located on the coastal terraces where the site index for Douglas-fir is much poorer, averaging 134 for the study areas. Though little is known of site quality for cedar, this species seems to compete with Douglas-fir more successfully on the coastal terraces. On these terraces, cedar occurs frequently as dominants in young stands, and there it dominates more of the stocked reproduction quadrants than elsewhere.

The relatively large number of cedar-dominated quadrants in partially cut areas is also attributed in part to advance reproduction which survived logging. The tolerant cedar and hemlock were better represented in the advance growth than Douglas-fir. Sixteen percent of the stocked quadrants on partial cuttings were dominated by advance reproduction as compared to only 3 percent on the recent clearcuttings (Table 2). One-third of all the cedars dominating quadrants in partially cut areas were advance growth. This reproduction is often injured by logging or fire, or is too suppressed for full recovery, therefore it is less desirable than subsequent reproduction.

The recent clearcuttings had the most desirable regeneration: 88 percent of all quadrants were stocked, 43 percent contained cedar, and 71 percent of the stocked quadrants were dominated by cedar or Douglas-fir, the two most desirable species. For partial cuttings, 72 percent of all quadrants were stocked, 40 percent contained cedar, and 58 percent of the stocked quadrants were dominated by cedar or Douglas-fir. The older, reburned clearcuttings were only 53 percent stocked, had cedar on only 25 percent of all quadrants, and cedar or Douglas-fir dominated 50 percent of the stocked quadrants. Furthermore, 15 percent of the stocked quadrants were domi-

[2]Average total height of dominant and codominant trees when 100 years old.

nated by shore pine (*Pinus contorta* Dougl.), which is encouraged by fire, and has little commercial value.

Environmental Factors

Of all environmental factors tested, only seed trees and ground cover density could be shown to have an influence on the abundance of Port-Orford-cedar seedlings. The net influence of seed trees is shown by Figure 2. Numbers of seedlings increased slowly from ratings 0 to 5, but increased rapidly with each higher rating from 6 to 10. Seed-tree ratings alone accounted for 44 percent of the variation in numbers of seedlings.

When seed-tree ratings are held constant, the relationship between ground cover and number of seedlings is as shown in Figure 3. Number of seedlings decreased rapidly as cover density increased from 0 to 0.5 but decreased more slowly for densities from 0.6 to full cover. No other environmental factors could be shown to have an influence on number of seedlings. This does not mean that no relationship exists, but only that no relationship could be demonstrated with the data used.

Discussion

Port-Orford-cedar grows typically in mixed stands. This study shows that in reproduction which has followed recent clearcuttings and partial cuttings, cedar is more prevalent than in the parent stands. But even more trees may be needed if this excellent wood is to be grown for the future in sufficient quantities to supply the markets it serves best. This study has indicated ways of cutting to induce reproduction of cedar.

Clearcutting is the most practical method of harvesting the large old-growth timber. Old growth opened up by partial cutting is especially subject to windthrow, and the large equipment required injures the trees that are left. But even if windthrow and excessive damage could be avoided, the large equipment would destroy much of the reproduction. Heavy equipment may be an advantage in clearcutting, however, because it eliminates much of the ground cover which hinders re-establishment of cedar.

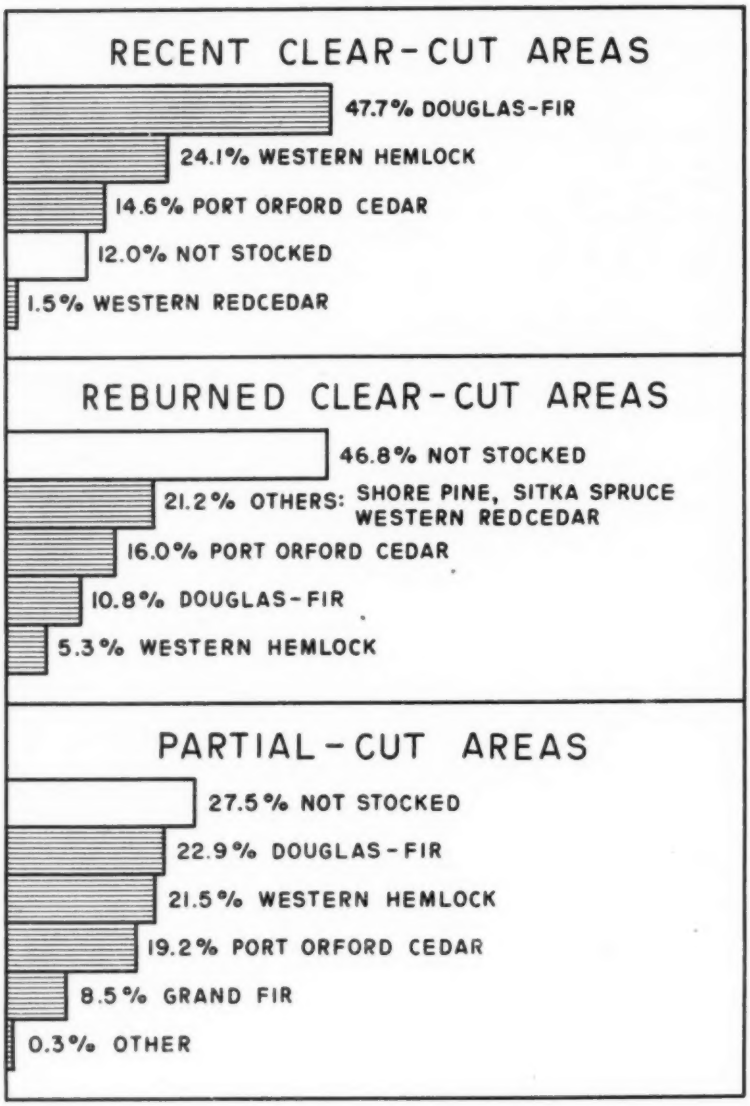


FIG. 1.—Percent of plots dominated by different species.

The clearcuttings of the past have been too large. Isaac[3] has shown that the seed of western redcedar, which is similar in size but only about one-half as heavy as the seed of Port-Orford-cedar, does not scatter as far from the parent trees as the seed of most associated species. Therefore Port-Orford-cedar probably has a short distance of flight also. This study has shown a marked reduction in reproduction beyond 4 to 6 chains from an average number of seed trees. Consequently, small clearcuttings, not more than 10 chains across, or about 10 acres for symmetrical units, should favor cedar reproduction. Because of the aggressive growth of Douglas-fir in the open, it may be necessary to weed the reproduction stand to keep cedar in the upper canopy where its full growth potential can be realized.

[3]Isaac, Leo A. Reproductive habits of Douglas-fir. 107 pp., illus. Charles Lathrop Pack Forestry Foundation. 1943.

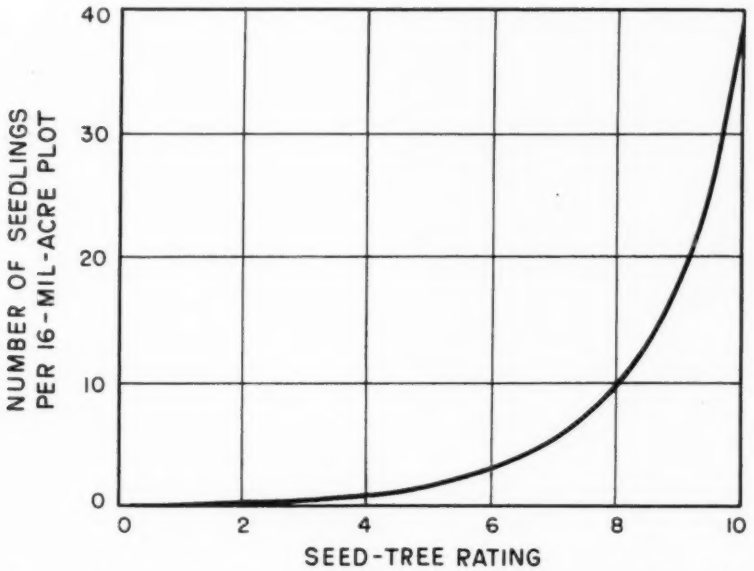


FIG. 2.—Relation of numbers of Port-Orford-cedar seedlings per 16-mil-acre plot to seed-source rating.

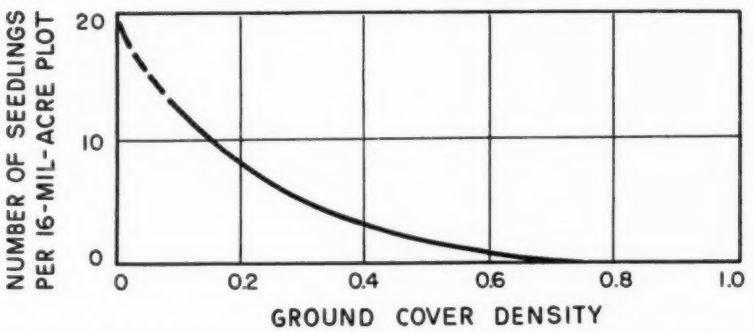


FIG. 3.—Effect of density of ground cover on the number of seedlings on 16 mil-acre plots.

Partial cutting of a shelterwood type should be very effective in regenerating cedar in young-growth stands from which small trees will be harvested. Less destructive equipment can be used, and if the stand is removed gradually, the residual trees should remain windfirm. Reproduction has been fairly good on old partial cuttings, despite the fact that the stands had been high graded for cedar. If other species primarily were removed, especially the shade-tolerant hemlock, the cedar should be favored by an abundant seed source and its own high degree of shade tolerance.

Both of these proposed methods of cutting should be tested in the future.

A lack of correlation between seedling abundance and several environmental factors indicates that cedar is not particularly sensitive to environment for germination and establishment. Observations verify this, for cedar is found abundantly intermixed with shore pine on wet, poorly drained flats near the coast; it grows well in mixture with Sitka spruce and western hemlock on coastal terraces, and with Douglas-fir and other species on better sites throughout its range. It mixes with sugar pine and western white pine (*Pinus monticola* Dougl.) in upper-slope manzanita fields of the Coast Range; with Jeffrey pine (*Pinus jeffreyi* Grev. and Balf.) and California incense-cedar (*Libocedrus decurrens* Torr.) on thin, dry serpentine soils where no species can prosper; and even with weeping spruce (*Picea breweriana* S. Wats.) on the highest peaks.

Summary

This study has shown:

1. Recent clearcut tracts have more completely restocked to desirable species than partially cut tracts.

2. Port-Orford-cedar was better represented in the reproduction stands than in the parent stands, whether clearcut or partially cut.

3. Both stocking and composition of the reproduction were inferior on old clearcuttings which had recently burned.

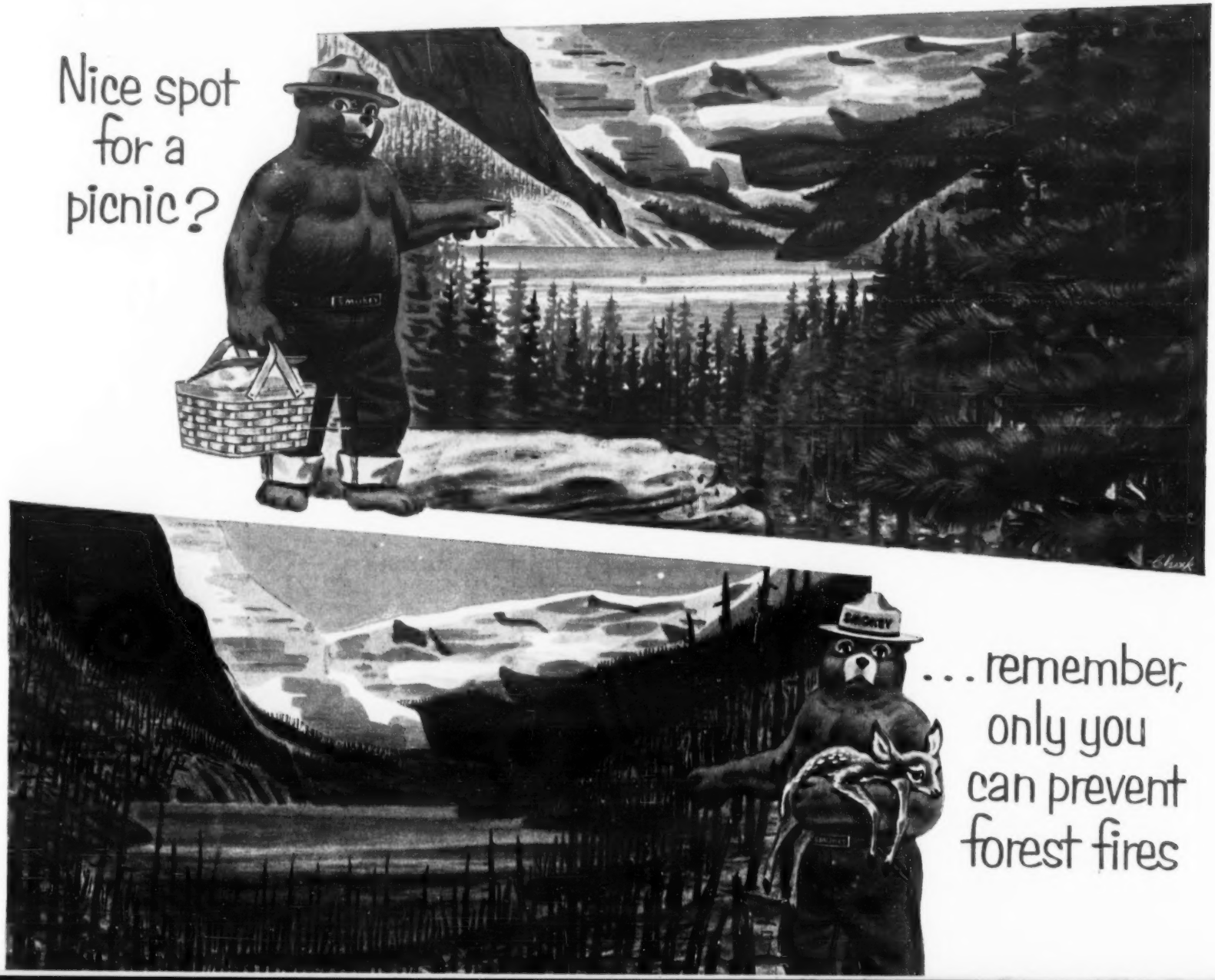
4. The frequency of plots stocked with cedar was not materially different on clearcuttings and partial cuttings.

5. Abundance of Port-Orford-cedar reproduction was significantly and strongly influenced by the number and distance of seed trees.

6. Dense ground cover adversely affected cedar establishment.

7. No statistically significant effect on seedling occurence could be demonstrated for geological formation, soil type, soil moisture, soil depth, seedbed condition, humus and litter depth, aspect, slope, slash burned or unburned, basal area of residual stand, and Douglas-fir site class.

8. Either clearcutting in small units, not more than 10 chains across, or shelterwood cuttings in which primarily other species are removed should improve regeneration of Port-Orford-cedar.


Nice spot for a picnic?
SMOKEY
. . . remember, only you can prevent forest fires

GOOD ROADS ARE IMPORTANT for effective fire control—as well as economical logging. Building and maintaining these lifelines of the woods calls for the working power and precision control Allis-Chalmers builds into its motor graders. Here, a heavy-duty AD-40 shapes and maintains a forest road in Idaho.

One thoughtless moment and it can all go up in smoke

Last year there were 190,000 forest fires, nine out of ten caused by human carelessness. We lost 20 million acres of forest. Cost? One billion dollars in timber—or enough lumber to house a city of 600,000 population. There was untold damage to wildlife and recreational areas. Valuable watersheds were damaged and the stage set for devastating floods.

How can we stop these great losses? "Smokey," U.S. Forest Service and State Foresters' "expert" on the subject, suggests:

BE SURE you crush out your smokes. Use ash trays in cars.

BE SURE matches are out. Break matches in two. When you can hold the burned end between your fingers, you are sure no fire is left.

BE SURE your campfire is out. Drown it, then stir the coals and drown again.

BE SURE you burn debris in a safe manner, and get a permit if required.

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AS AN AID TO FORESTERS in your efforts to prevent loss from forest fires, this message was placed before readers of the more than 4,500,000 copies of the *Saturday Evening Post*, September 18 issue.

(Reprints available on request)

Infiltration, Erosion, and Herbage Production of Some Mountain Grasslands in Western Colorado[1]

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MANAGEMENT OF RANGELANDS for maximum forage production and ample watershed protection calls for periodic appraisals of the plant cover and soil conditions. To make a sound appraisal, information is needed on conditions of soil and plant cover that are most effective in producing forage and controlling erosion. The purpose of the study reported here was to provide such information for the mountain grasslands of western Colorado.

Mountain grasslands occur in western Colorado at elevations of 8,000 to 10,500 feet above sea level. Judging from the present condition of grasslands in protected locations, the original cover of mountain grasslands was a dense stand of Thurber fescue. Where grazing use has been light, the original grass cover appears to have changed very little. Where livestock grazing has been heavy, Thurber fescue has been replaced by various mixtures of other grasses, forbs, and shrubs. On coarse-textured soils, Idaho fescue and needlegrasses have commonly replaced Thurber fescue. On finer textured soils, especially in the bottom lands and meadows, it appears that Thurber fescue was replaced by Kentucky bluegrass. Other areas are now occupied by nearly pure stands of dandelion or mixtures of taller forbs.

To obtain information which would apply to a wide area of western Colorado, conditions were sampled on four national forests, the Gunnison, Grand Mesa, White River, and the Routt. The observations reported here were made in six common plant-cover types which are readily recognizable by those directly concerned with the management of mountain grasslands. These types are dense Thurber fescue, open Thurber fescue, needlegrass, bluegrass, lush weed, and poor weed, and are characterized as follows:

Dense Thurber fescue. — Dense stands of Thurber fescue, plants not more than 2 or 3 feet apart. Other grasses and forbs few and scattered. Bare soil less than 20 percent.

Open Thurber fescue. — Thin stand of Thurber fescue, plants generally more than 4 feet apart. Idaho fescue, needlegrass, bluegrass, or sedges common. Perennial forbs common to abundant but not predominant.

Bluegrass.—Kentucky bluegrass dominant, generally forming a sod. Forbs inconspicuous to common. Dandelion the most frequent forb.

Needlegrass.—Thin to moderately dense cover of needlegrass and Idaho fescue. Forbs common to abundant and variable in composition.

Lush weed.—Dense luxuriant cover of forbs, principally cinquefoil, geranium, aspen fleabane, lupine, and wyethia. Grasses scattered and comprising a minor portion of the herbage volume.

Poor weed. — Open cover of forbs, mainly dandelion and sneezeweed; grass cover sparse, rabbitbrush common. Bare soil conspicuous, occupying over 50 percent of the surface.

Watershed conditions were investigated by applying artificial rainfall to small plots with the Rocky Mountain infiltrometer[3] and measuring the amount of surface runoff and accompanying sediment. Rainfall was applied at a rate of 5 inches per hour for a 50-minute period to plots which were wet the day before. The difference between the total water applied and the total runoff during the last 20 minutes of each test is the basis for the calculation of the infiltration rate. The total amount of soil washed from the plot during the 50-minute run is converted to a per-acre basis to give a measure of erodibility. Sampling sites varied from 3 to 8 acres in size, and at each site six infiltrometer plots were randomly selected.

Plant cover was sampled by 25 plots at each site. The amount of ground surface occupied by plants, litter, and bare soil was estimated by the square-foot-density method. Production of grasses, forbs, and shrubs on each plot was determined by harvesting, air-drying, and weighing the herbage produced. Where plots were grazed, the utilization was estimated before plots were harvested and used to adjust for total production.

Some characteristics of the plant cover types as well as infiltration rates and erosion losses are summarized in Table 1.

The dense Thurber fescue type produced an average of 2,460 pounds of vegetation, nearly all of which was grass. On the four sites sampled, Thurber fescue made up 53 to 94 percent of the total grass cover. The greatest amount of bare soil on any site was 15 percent and the weight of litter cover varied from 6,000 to 14,000 pounds per acre. Soils were deep, mellow, and porous, with a high content of organic matter. Topsoil texture varied from loam to clay loam. Infiltration rates were very high and erosion was low. These sites provide an index of maximum natural production of mountain grasslands in western Colorado as well as maximum protection of soil under optimum conditions.

Open Thurber fescue sites produced about 80 percent as much total vegetation and 64 percent as much grass as dense Thurber fescue. Thurber fescue comprised 47 to 78 percent of the total grass

[1]Paper presented at 53rd annual meeting, Society of American Foresters, Colorado Springs, Colo., September 1953.

[2]Forest Service, U. S. Dept. Agric., with headquarters at Colorado A & M College, Fort Collins, Colo.

[3]Dortignac, E. J. Design and operation of Rocky Mountain Infiltrometer. Station Paper No. 5, Rocky Mountain Forest and Range Expt. Sta. February 1951. (Processed.)

TABLE 1.—GROUND COVER, HERBAGE PRODUCTION, INFILTRATION RATES, AND MEASURED EROSION FOR COVER TYPES

Cover type	Bare soil[1]	Live vegetation[2]		Litter[2]	Infiltration rate	Total erosion
		Grass	Weeds			
	Percent	*Lbs/acre*	*Lbs/acre*	*Lbs/acre*	*In./hr.*	*Lbs/acre*
Dense Thurber fescue	6	2,034	426	10,238	4.7	76
Open Thurber fescue	19	1,298	640	9,306	3.6	646
Bluegrass	14	1,031	532	1,223	1.5	455
Needlegrass	38	470	608	1,754	3.2	1,068
Lush weed	28	337	1,553	2,167	4.4	788
Poor weed	58	184	1,117	512	2.9	4,375

[1]From infiltrometer plots.
[2]From plant-cover plots.

cover. On the three sites sampled bare soil was exposed on 9 to 21 percent of the area. The weight of litter ranged from 5,000 to 11,000 pounds per acre. Topsoil texture was loam to clay loam, but soils here appeared more compact than those under dense Thurber fescue. Infiltration rates averaged 3.6 inches per hour and ranged from 2.6 to 4.2 inches per hour. Soil loss varied from 479 to 964 pounds per acre and averaged 646 pounds per acre. The greatest runoff occurred on plots with the least amount of Thurber fescue. While neither forage production nor soil protection was as good as the dense Thurber fescue type, the open Thurber fescue type appears to be satisfactory for both production and protection.

The bluegrass type produced an average of 1,563 pounds of vegetation per acre of which 66 percent was grass. Kentucky bluegrass formed 82 to 95 percent of the total grass cover. Dandelion was the dominant forb on these sites. Surface soils varied from a silty clay to a clay loam and the ground appeared harder and more compact than on other sites. In general, bluegrass tends to dominate the finer textured soils when Thurber fescue is overgrazed. Average bare soil exposed varied from 11 to 16 percent on the three sites sampled. The average weight of litter was 1,223 pounds per acre. Infiltration rates varied from 1.0 to 2.3 inches per hour. The lower infiltration rate on bluegrass than other types sampled is probably a result of the finer textured soils on which it is dominant and the characteristic sod formation. However, the low erosion rates, averaging only 455 pounds per acre, are probably due primarily to the dense sod but may also be influenced by soil texture and structure. Forage production on bluegrass sites is relatively high when precipitation is nearly normal, as it was during the study period. Protection against erosion appears to be adequate on bluegrass sites, yet the large volume of surface runoff to be expected from extensive areas of bluegrass may cause gullies and streambank cutting on areas downstream.

The needlegrass type produced only 45 percent as much vegetation as dense Thurber fescue and only 19 percent as much grass. Letterman needlegrass and Idaho fescue made up 58 to 88 percent of the total grass cover. Many forbs were represented but dandelion was the most common. Surface soils varied from loam to clay loam and from porous to compact. Bare soil was exposed on 18 to 63 percent of the surface on the four sites sampled and the average weight of litter was 1,754 pounds per acre. Infiltration rates ranged from 2.9 to 3.6 inches per hour and erosion from 500 to 2,200 pounds per acre. While no serious erosion was observed in the field, the relatively high erosion potential of these sites indicates the need for careful management. Furthermore, the sites with needlegrass types are producing much less forage than if occupied by the better range types already described.

Lush weed sites produced an average of 1,890 pounds of herbage per acre, of which only 18 percent was grass. Principal forbs were geranium, aspen fleabane, slimstem cinquefoil, and mulesear wyethia. The lush weed type may develop as a result of gradual improvement of poor weed sites, or occasionally from forest fire. Surface soils of lush weed sites varied from loam to clay loam and were porous to slightly compact. On the four study sites from 9 to 51 percent of the area was bare. Weight of litter varied from 600 to 4,000 pounds per acre. Infiltration rates were high, ranging from 3.9 to 4.6 inches per hour. Although soil losses averaged only 788 pounds per acre, they amounted to 2,200 pounds per acre where 50 percent of the surface was exposed. The plant cover on lush weed sites provides little forage for cattle, but does provide more and better forage for sheep and deer than some of the better grasslands.

The poor weed type produced 1,301 pounds of grass and weeds, most of which was perennial forbs. The most abundant plants were dandelion, sneezeweed, and rabbitbrush. On the two sites sampled, bare soil was exposed on 50 to 75 percent of the ground surface. The average weight of litter was only 512 pounds per acre. Soil texture varied from loam to clay loam, the soil surface being compact on one site and loose and porous on the other. Infiltration rates were 2.5 and 3.4 inches per hour, respectively. Erosion ranged between 3,000 and 5,700 pounds per acre. These rates are considered excessive and both sites showed evidence of considerable soil loss. It appears obvious that poor weed sites are unsatisfactory in both forage production and soil protection.

Summary

Results of this study show that both dense and open stands of Thurber fescue provide abundant forage and ample watershed protection. Lush weed sites, when managed to prevent soil exposure and compaction, also give good watershed protection. The lush weed type furnishes little forage for cattle but is satisfactory for sheep and game. The bluegrass type normally produces adequate forage yields and the sod prevents excessive erosion from the site. Yet

the volume of surface runoff from this type is greater than that from other grassland types. The high volume of runoff from any appreciable area of bluegrass may cause gullying and channel cutting on lower lying (downstream) lands. The needlegrass type is not a good forage producer and unless carefully managed can deteriorate to a condition where serious erosion occurs. Management to increase the density of the more desirable grasses will benefit both forage production and watershed protection. The poor weed type provides inadequate watershed protection and little forage—only about a tenth as much as dense Thurber fescue sites. These sites need careful management and possibly reseeding if they are to show substantial improvement in a reasonable period of time.

A Harvesting Technique for Beetle-killed Engelmann Spruce on the Western Slope of Colorado

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THE HISTORY of the Engelmann spruce bark beetle's recent epidemic outbreak, one that nearly liquidated Colorado's vast spruce forests, is a matter of record. The U. S. Forest Service was committed to a salvage program. It was of considerable importance that salvage operations be encouraged to avoid the possibility of total loss through fire, rot, and windthrow. Operations were started, but left much to be desired from the standpoint of good management because of damage to green trees, impaired watershed values, and damage to the site.

The study reported here was made to develop a technique by which salvage operations could be carried out while leaving the forest in a condition acceptable to the requirements of good management. A secondary objective was to devise ways to increase the profit margin to the operators, thereby obtaining their whole hearted cooperation, a matter essential for the success of a controlled harvesting plan.

Economic Values

A brief resume of the economic values of the Engelmann spruce—subalpine fir forest type is essential in order to view the problem in proper perspective. These economic values have been grouped into five categories: watershed, recreation, hunting and fishing, grazing, and timber production.

The watershed value of this type is of the utmost importance, for it is here that the major portion of all Colorado's domestic and irrigation water is stored in the form of snow. Four large river systems have their beginning in the spruce: the Platte, the Arkansas, the Rio Grande, and the Colorado. The down-stream states certainly are interested in an orderly, adequate flow of useable water. Through the relatively simple process of determining the water yield from the Engelmann spruce-subalpine fir forest type, then multiplying this figure by the average price paid per acre foot of water, and dividing this value by the total forest type acreage, a crude but usable value per acre may be obtained. This value was determined to be $3.87 per acre per year.

Recreation is an important industry in Colorado. Even excluding the hunter and the fisherman the total annual revenue derived from the tourists and recreationists is tremendous. Dividing the total recreational expenditure by the number of acres, it was found that recreation in the Engelmann spruce type produced approximately $3.23 per acre per year.

For many people Colorado is the hunter's and fisherman's paradise. By allocating the proper amount of the sportsman's expenditures to the spruce-fir type, it was estimated that the economic value for this use was $1.89 per acre per year.

The livestock industry is also quite important in the economy of the state. The summer ranges of this industry for the most part lie within the Engelmann spruce—subalpine fir forest type. Therefore it is only proper that this value be considered. Using the same procedure as before, it was estimated that $0.804 per acre per year was the value to be derived from grazing.

Timber production from this forest type has the lowest value due to the shortness of the growing season, poor site, and other factors. It was determined that timber yields a value of $0.10 per acre per year.

These economic values have been skimmed over rapidly and no doubt there are many who would question the procedures used. While they are only approximate, it is felt that the relationship existing between them would not be appreciably changed if the calculations were based on more refined data.

The approximate economic values to be derived from the spruce-fir forest type are summarized as follows:

	Per acre per year
Watershed value	$3.87
Recreational value	$3.23
Hunting and fishing value	$1.89
Grazing value	$0.804
Timber value	$0.10

As may be seen from the foregoing, impaired watershed values, damage to the site, and damage to

green trees resulting from salvage operations could lead to serious economic losses.

The Study

The first step in an attempt to find a solution to the problem of harvesting the spruce without excessive damage to the residual forest was to analyze the current practices. This was accomplished by a series of sample plots on which all green trees were tallied prior to the harvesting operation. After the felling phase had been completed, a second tally of remaining green trees was made. A third tally followed at the conclusion of the skidding operation. The causive agency of green tree loss could therefore be isolated insofar as felling or skidding was concerned. It was determined that the felling operation destroyed 40 percent of the original number of green stems on the plots. Of the green trees still remaining after the felling operation, skidding destroyed another 40 percent. There was a total loss of 65 percent due to the combined felling and skidding operations.

After observing existing harvesting practices and comparing results obtained from the six sample plots established in areas being harvested, several factors contributing to the loss of green trees were evident:

1. There was not a distinct coordination between the felling and the skidding phase of the operation.

2. In most cases each crew of fallers were not given definite instructions concerning the direction to fell timber assigned them to cut.

3. Generally each crew of fallers was not given definite instructions regarding felling of dead spruce into clumps of green trees and grazing standing green trees.

4. Each tractor operator was not instructed as to the skidding plan and shown routes of travel to the landing from the woods and return.

5. Each man who chose the logs to be removed from the woods by the skidding tractor, (choker-setter) was not given instructions in the proper sequence of choosing logs and thoroughly as to the skidding plan.

6. Competent supervision of each phase of the harvesting operation was not provided.

Results

Using the factors contributing to the loss of green trees as determined from the study of existing harvesting practices, a plan was drawn up to alleviate these losses. The basic features of this plan were:

1. Plan, and actually mark on the ground, a skid trail to be used in skidding logs from a specific area.

2. Designate, on the ground, the direction of fall for timber within the specific area to be skidded over the previously marked trail.

3. Along the boundaries of each skid trail, designate certain trees to be felled in such a manner that an unusually high stump, approximately 30 inches, would remain.

The skid trails were laid out to take advantage of the topography, and the timber tributary to each skid trail was felled in the conventional 30° herring-bone pattern. The "high-stumps" located along the edges of the skid trails were of value not only in keeping the skidding tractors on the trail, but also in protecting adjacent green trees from the siwashing action of the logs. As each tractor was required to stay on the skid trail, logs had to be yarded to the tractor by means of the skidding line. When the logs were pulled on to the skid trail, the high stumps acted as pivot points, thus saving the green trees on the downhill side of them. While there was a substantial reduction in the loss of green trees due to both felling and skidding, there was still room for improvement. Therefore the entire plan was re-examined seeking to reduce losses still further. It was found that better training and instructions for the choker setters should be helpful and more "high stumps" should be employed, not so much along the skid trail but in the adjacent areas where clumps of green trees or reproduction would be in danger of skidding damage.

The same basic plan with the above mentioned additions was employed on another setting. The results were very satisfactory, for skidding losses were further reduced. There was not an appreciable change in the damage chargeable to the felling phase. This would indicate that there will be certain unavoidable losses due to felling. Logs lying on the ground take up space, and 35-40 cords of wood per acre will take up considerable area.

Results on the forest.—In order to check the validity of the harvesting plan, another setting was layed out and harvested. The losses of green trees due to felling was approximately the same as before, however the skidding losses were amazingly low, approximating 10 percent. The average losses sustained under the harvesting plan were: felling 25 percent; skidding 19 percent; total loss 40 percent. This left 800 or more green trees per acre which would insure proper stocking for future crops.

The watershed value has not been seriously affected, for while the skid trails were totally devoid of vegetation, the damage is localized and can be easily repaired. Earthen dams pushed across the trail by a bulldozer would quickly and cheaply serve to prevent erosion. Perhaps it might be desirable to sow grass on the skid trails to quickly re-establish ground cover, increase grazing capacity, and influence snow storage.

The recreational values will be affected only slightly. I seriously doubt if the average tourist would be aware that the beetle-killed timber had been harvested. Hunting and fishing should not be affected adversely.

Results for the operation.—To determine the economic effect this harvesting plan would have upon an operator, a very simple time study was made. First, the existing skidding practices were timed and volume tallied. Then skidding under the plan was timed and volume tallied again. From these data it was found that there was a production increase in volume skidded per day of approximately sixty-five

percent for the D-6 cats and twenty-seven for the D-4 cats. This should prove to be a strong factor in securing the cooperation of any operator.

The application of this plan by operators will entail very slight additional harvesting costs. There will be little if any increase in felling expense because the fallers are generally paid on a per tree basis and also little difficulty was encountered in felling according to plan. Skidding costs will actually be decreased due to substantially increased production with the same manpower and equipment. Supervisory costs will be increased slightly, for generally the operators must provide a training program for the key personnel in order to apply this plan efficiently. The amount of training required is not great and little difficulty should be experienced in attaining competent employees.

The actual layout work of skid trails, direction of felling, and designation of highstumps may be accomplished at the rate of 20 chains per hour. This rate will vary with the experience of personnel and changes in topography and timber.

Conclusions

Therefore it would appear that the beetle-killed spruce may be harvested without entailing excessive damage to the other more important values involved. Good forest management objectives will be met, watershed and recreational values will be safeguarded and the operations will yield a larger profit.

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FISCAL YEAR MEMBERSHIP CAMPAIGN

Section Box Score

Section	Applications received[1] Proposed 1954 quota	November listing	Total fiscal year
Allegheny	100	6	68
Appalachian	100	2	48
Central Rocky Mountain	45	1	26
Central States	110	1	80
Columbia River	140	2	56
Gulf States	105	3	57
Inland Empire	30	1	39
Intermountain	30	0	14
Kentucky-Tennessee	30	0	5
New England	95	0	54
New York	65	1	40
Northern California	120	0	34
Northern Rocky Mountain	30	0	35
Ozark	55	2	49
Puget Sound	80	1	61
Southeastern	145	5	128
Southern California	20	0	2
Southwestern	35	0	7
Upper Mississippi Valley	60	8	64
Washington	45	0	7
Wisconsin-Michigan	60	5	11
Totals	1,500	38	885

[1]Student, Junior, Affiliate, Associate (initial) grades only.

FISCAL YEAR MEMBERSHIP CAMPAIGN

School Box Score

School	Student applications received November listing	Total fiscal year
Alabama Polytechnic Institute	0	7
University of California	0	21
Colorado A & M College	1	18
Duke University	0	12
University of Florida	0	16
University of Georgia	0	38
University of Idaho	0	29
Iowa State College	6	32
Louisiana State University	0	14
University of Maine	0	16
University of Massachusetts	0	16
Michigan State College	0	25
University of Michigan	0	22
University of Minnesota	0	21
University of Missouri	0	20
Montana State University	0	19
State University of New York	0	23
North Carolina State College	0	19
Oregon State College	0	17
Pennsylvania State University	0	33
Purdue University	0	19
Utah State Agricultural College	0	8
University of Washington	0	28
West Virginia University	5	21
Yale University	0	3
Totals	12	497

Notes

The Accuracy of Scale Determinations on Aerial Photographs[1]

THE SCALE of an aerial photograph is determined by comparing the distance between two points on the photograph with the corresponding distance determined on the ground or obtained from an established map. Theoretical considerations indicate that the line connecting the two points should pass near the center of the photograph. Due to a lack of suitable control points other lines are frequently measured, a practice which leads to a certain loss of accuracy of the calculated scale. In order to determine the magnitude of the error of scale determinations a number of differently located scale check lines were measured on various photographs. The suitability of different such lines was determined by calculating the standard error of repeated scale determinations using photographs of a nominal scale of 1:20,000 and 1:12,000. Both series of vertical photographs were taken in the vicinity of State College, Pennsylvania, with ground elevation ranging from 700 to 1,300 feet above sea level. On a single exposure the maximum difference in elevation was 400 feet.

Calculation of Scale

The horizontal ground distance D between two control points with elevations E_1 and E_2 above sea level is obtained by multiplying the map distance with the *scale factor* of the map. The elevation E_1 and E_2 are read from the map. The scale factor corresponding to a scale of 1/62,500 is equal to 62,500. For a photo distance d and a focal length f, the approximate flying height above sea level is next obtained by the formula:

$$H = \frac{fD}{d} + \frac{E_1 + E_2}{2}$$

The scale at sea level for the line between the selected control points is then equal to:

$$S = \frac{f}{H}$$

In order to allow proper comparisons between various scale determinations, all calculated scales or scale factors must obviously be reduced to sea level, or a common datum.

Standard Error of Scale Factor on 1/20,000 Photographs

Six pairs of scale check lines were measured on nine different photographs as shown in Figure 1 and designated as follows:

a, a' across flight line
b, b' along flight line
c, c' across corners
d, d' across corners
e, e' diagonals
f, f' across center

An exploratory analysis of variance of the data indicated that scale variations between photographs were not significant. This finding supports the contention of Rogers[2] that is not necessary to compute the scale for each of the photographs of a project, but that it is sufficient to determine the sea

[1]Authorized for publication on October 20, 1953, as Paper No. 1831 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

[2]Rogers, E. J. A short cut for scaling aerial photos. Northeast. Forest Expt. Sta. Paper No. 20. 1949.

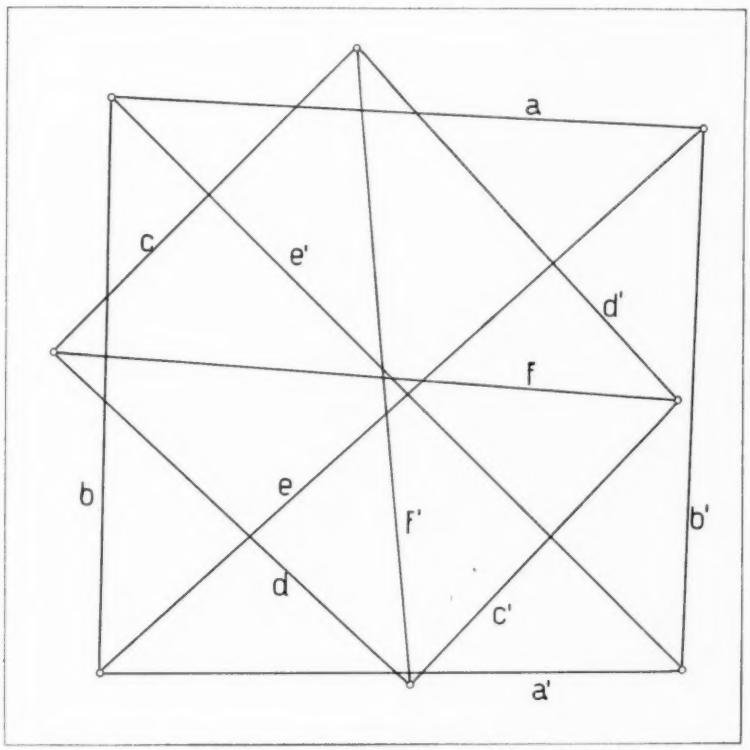

FIG. 1.—Determining error of scale factor.

level scale for a flight line or an entire project by determining the scale for a limited number of randomly selected photographs only. Another result of the analysis of variance is that the variation in scale within pairs of symmetrical check lines is greater than between individual pairs. The average scale computed from a pair of symmetrical check lines will therefore be more accurate than the average obtained from two randomly selected check lines.[3]

In order to find which pair of check lines gives the most accurate estimate of scale, the average of the 12 scale determinations was calculated for each of the nine photographs. This average determined for each photograph was considered to represent the true scale, and the standard error of the various check lines and pairs of check lines from this average of each photograph was calculated. The results of these calculations are given in Table 1. In nearly all cases the paired symmetrical check lines give a more accurate estimate of scale than two single check lines. This difference is most pronounced in the diagonals and the across center lines, both of which cross each other at right angles near the photo center. The standard error of two non-symmetrical check lines is twice as large as the standard error of symmetrical pairs of observations, which means that four times as many non-symmetrical check lines would have to be measured to obtain the same accuracy as provided by a pair of symmetrical check lines.

Standard Error of Scale Factor on 1/12,000 Photographs

Determinations of scale factors and their accuracy on 1/12,000 photographs were made in a similar way as for the 1/20,000 photographs. Only three pairs of symmetrical check lines were measured, namely as follows:

[3]Landis, G. H. The accuracy of scale and height measurements on aerial photographs. Thesis (manuscript). The Pennsylvania State College, 1954. The analysis of variance is reported in detail by Landis.

TABLE 1.—STANDARD ERROR OF SCALE FACTOR MEASUREMENTS FOR 1/20,000 PHOTOGRAPHS

Class of scale check lines	Standard error of scale factor: for single check lines		for average two symmetrical check lines
	s	$s/\sqrt{2}$[1]	
Across flight line	354	250	259
Along flight line	439	310	290
Across corners	354	250	233
Across corners	350	247	203
Diagonals	238	168	76
Across center	182	129	63

[1]In order to compare the accuracy of a scale determination based on a single check line with the accuracy obtained for the average of a pair of symmetrical check lines, it is necessary to divide the standard error s of a single observation by $\sqrt{2}$.

TABLE 2.—STANDARD ERROR OF SCALE FACTOR MEASUREMENTS FOR 1/12,000 PHOTOGRAPHS

Class of scale check lines	Standard error of scale factor: for single check lines		for average of two symmetrical check lines
	s	$s\sqrt{2}$[1]	
Across flight line	256	181	85
Along flight line	234	165	84
Diagonals	47	33	24

[1]See footnote to Table 1.

a, a' across flight line
b, b' along flight line
c, c' diagonals

The results of the analysis of the data are shown in Table 2. The relative advantage of determining the scale for the average of two symmetrical check lines is even more pronounced than in the previous example. Again, the average of two diagonals crossing each other near the center of the photograph was a great deal more accurate than the average obtained from the two lines along and across the flight line.

Conclusions

An accurate determination of the scale of aerial photographs is obtained by measuring a pair of check lines crossing each other at more or less right angles near the center of the photograph. Either diagonals or other lines crossing at right angles near the principal point may be measured. The standard error of the scale factor obtained from the average of two such measurements expressed in percent of the scale factor is:

0.3 percent for 1/20,000 photographs, and

0.2 percent for 1/12,000 photographs.

Obviously, for many purposes, a high degree of precision for scale is not required and the measurement of a single check line may be all that is necessary. It is important, however, to know the error of various methods of scale determination and to know how to obtain an accurate estimate of scale when the need arises.

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A Bark Beetle Attacking Scions of Grafted Slash Pines

By attacking the scions of slash pine grafts *Pityophthorus pulicarius* (Zimm.), a small bark beetle, may join the ranks of noxious forest insect pests. This new damage by the beetle was demonstrated during the past season's grafting work of the Forest Genetics Project at the Southeastern Forest Experiment Station's Lake City, Florida, Research Center. The damage to grafted stock being prepared for seed orchard establishment was extensive and the cause of considerable concern.

Under normal conditions the

small bark beetle, 1.3 to 2.0 mm. long, is usually content to attack the tips of newly felled or dying pines and the tips of branches which are in the process of natural pruning. Thus, in the past it has been of little importance. However, fresh scions apparently meet its requirements for attack. This is disappointing, especially since the grafts were seemingly successful. Scions were attacked in the lath house and in the field replicate 10 to 12 miles away with losses of approximately 25 percent and 15 percent, respectively.

The grafts were made during the latter part of January and the early part of February. A bottle-graft technique was used with the dormant scions collected from trees selected for high gum yield and superior qualities of growth and form.

In late March and April the buds of the scions began to elongate and the unions seemed successful. At this time the attacks were noticed. They were chiefly located in the old growth of the scion above the union, though an occasional entrance hole was noted in the elongating tip. A few scattered unsuccessful attacks were also observed in the tips of the stocks where the beetles had been pitched out by vigorous growth of the stock.

The first sign of attack is the frass which the beetle pushes out as it bores into the tip. This may be easily overlooked since it is inconspicuous. The entry is quite often made at the base of a needle fascicle or through an old needle fascicle scar. The first easily noticed evidence is the dying of the old needles, usually starting at the bottom of the scion just above the union. The elongating tip remains green for some time. The scion wood at the union may remain healthy up to three months after the upper portion has died. In one particular instance the scion below the union sprouted a new bud.

The attacking beetle bores through the bark and wood to the pith where a nuptial chamber is constructed. The egg galleries run out from it, generally parallel to the wood. Eggs are laid singly in side niches in the wood and pith. The larvae feed in the wood, though often meandering a bit to feed just beneath the bark. The mature beetle bores out through the bark to start another generation. In all probability the life cycle is less than 2 months under favorable conditions.

One of the curious aspects of this particular incidence is that there appeared to be a definite relationship between the source of the scion and its susceptibility to attack. Scions from one particular tree were unsuccessfully attacked and 100 percent of the grafts, both in the lath house and field, were successful.

The insect is indigenous to pine areas and species improvement work will usually be accomplished near the forest. The "production" phase of this type of work will entail extensive grafting. Thus, this insect may cause serious losses unless corrective measures are taken. From experiences with other bark beetles, benzene hexachloride should be one of the best insecticides to prevent attacks. In working with grafts frequent applications in dust form would probably be advisable.

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Concrete Beds for Nursery Production

In certain areas of the United States, primarily in California and the southwestern states, trees for forest planting are raised in individual pots or tin cans. The species raised by this method, which is necessary for stock used on semi-arid planting sites, are generally eucalyptus, acacias, certain pines, and cork oak.

A method of watering trees in such nurseries has been developed and tried for one year now in Libya by the author, who is on an assignment with the FOA mission in that country. This procedure gives promise of lowering costs and labor needed in a nursery operation devoted to raising trees of this type. The system, in essence, consists of the construction of concrete watering beds or

FIG. 1.—A typical forest nursery in Libya before the introduction of the concrete bed system. Watering was done by overhead sprinkling and tree losses were high. In addition the trees had to be moved about every two weeks to break root contact with the soil.

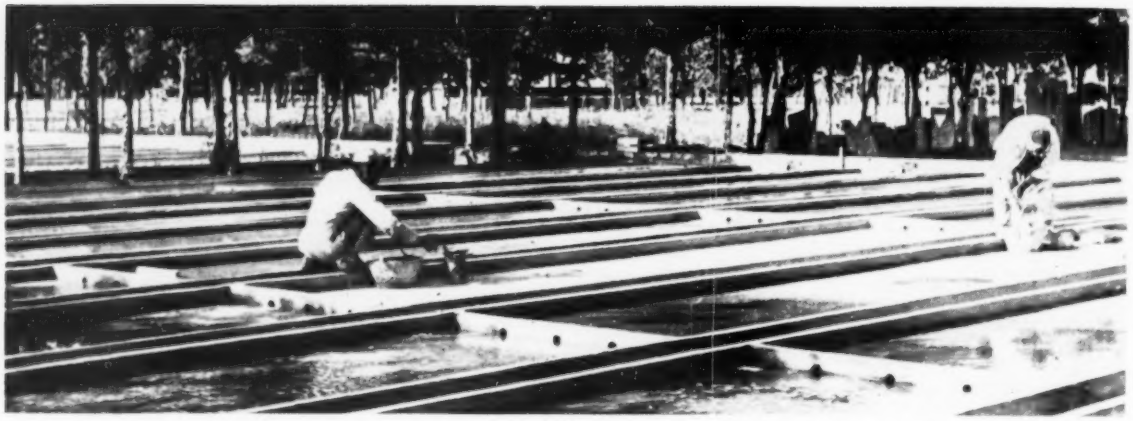


FIG. 2.—General view of the concrete bed system. The concrete conduit for carrying water from the reservoir is at the *(upper right)*.

troughs in which the cans or pots are placed and the trees watered by flooding the beds at appropriate times.

The beds in use in Libya were constructed of regular 1:2:3 mix concrete and are 4½ feet in width with a uniform slope of 1:400. The bottoms of the beds are 4 inches thick and the sides 3 inches thick. The sides extend about 4 inches above the bottoms, (Fig. 2). The cans are placed in the beds after being prepared by punching two holes in the side at the bottom end with an ordinary beer can opener (Fig. 3). Water is conveyed to the beds by means of a concrete conduit, although ordinary pipe can be used. The amount of water needed is soon gauged easily but in our experience has been not more than 30 gallons per 1,000 trees for each watering period, which will vary in time from 3 to 7 days depending on weather conditions and size of stock.

The costs of the beds will vary with cost of materials and labor but in Libya, where concrete is expensive and labor is cheap, the cost was about $3.00 per lineal yard of nursery bed which makes the cost over a 20 year amortization period less than $1.00 per 1,000 trees annually. This cost is more than equalized for the following reasons:

1. Mortality is reduced. Previous experience with species susceptible to leaf burning, such as the acacias, showed mortality rates as high as 25 percent when an overhead sprinkling system was used. Water droplets on the leaves, from such a system, induce leaf burning in bright sunlight and this has not been a factor in operation of the

FIG. 3.—A can showing the triangular opening at the bottom made by the beer can opener. Two holes are generally placed in each can.

FIG. 4.—A eucalyptus *(Eucalyptus gomphocephylla)* 7 months from seed which was moved into the concrete beds 4 weeks after transplanting with typical fibrous root development.

concrete bed system. Mortality has been less than 2 percent from all causes and these have been primarily due to unevenness in the bed structure and improper preparation of the cans.

2. Expensive outlay in an overhead sprinkling system is eliminated and maintenance is at an absolute minimum. There are no leaky faucets with this system.

3. One man can easily water as many as 500,000 trees a day by this system which simply involves letting the water into the beds for a certain period and then shutting off the water supply.

4. Weeding is almost entirely eliminated. Only 1 man hour per 1,000 trees has been necessary in the nurseries where this system is in use.

5. Movement of trees, which is necessary about every two weeks when the cans or pots are placed on the ground is eliminated entirely. The roots will not penetrate the concrete as they do the ground and it has been found that they will grow satisfactorily in one place during their entire nursery life.

6. Water use is decreased. There is less evaporation of water than with an overhead sprinkling system and none of the water soaks into the ground.

One precaution that is essential is that the beds be constructed with an absolutely uniform slope; otherwise water will stand in the low places and some trees will receive too much water. Root development has been uniformly good in the cans and a fibrous root system has resulted (fig. 4) which is so necessary for good survival at the planting site.

The concrete beds also have other nursery uses, as for seed extraction platforms and for seed beds in which are placed the standard soil, manure and fertilizer mixture. The work of transplanting seedlings grown in the beds is greatly simplified by the lack of long tap roots.

In summary, the concrete bed watering system has worked very well in its first year of trial and we are convinced that it is an economical method of raising potted or canned trees when such stock is necessary for good survival at the final planting site.

R. W. ABBOTT
Libyan-American Technical Assistance Service

A Study of the Effect of Grazing Upon Changes in Vegetation on a Watershed in the Southern Appalachian Mountains

To evaluate the effect of cattle grazing on forest vegetation, a 145-acre watershed at the Coweeta Hydrologic Laboratory was grazed by an average of six past yearling cattle, 4 months during each year starting in 1941 and ending in 1952. It was found from this study that the influence of grazing upon plant numbers, species numbers, and average height was more pronounced in the cove-hardwood forest type than in the oak-hickory or yellow pine hardwood types. This is mainly due to a greater number of palatable species. The cattle would use all available forage on the cove sites before moving on up the slopes to the other types in search of food. For all forest types there was a greater decrease and change in the total number of browsable plants on the unfenced and grazed plots than on the fenced and ungrazed control plots for trees, shrubs, legumes and other herbaceous vegetation. Grass vegetation decreased in the coves and oak-hickory types, but had a minor increase on the pitch pine-hardwood ridges. The results point to the fact that there is insufficient forage in the present dense hardwood stands to make grazing profitable. Also it is apparent that cattle damage young trees of desirable species, thus reducing the quality and altering composition of the stand. The fact that cattle did not thrive on the forage present is ample evidence that it is not profitable to graze Southern Appalachian woodlands even at the light stocking used in this study if the land is to be managed for its water and timber values. *Abstract of thesis for the degree of M.S.*

JERRY G. WILLIAMS
Michigan State College

Ernst Albert Sterling (1878-1954)

Ernest A. Sterling died at his home in Montrose, Pa., on September 1, 1954.

Born in Brooklyn, Pa., he graduated from Cornell University in 1902 with the degree of Forest Engineer and carried on further study in Germany and Switzerland. He started his career under Gifford Pinchot in the Bureau of Forestry but entered private work in 1907 as forester for the Pennsylvania Railroad and has since then been prominent in the private field. He was manager and vice president of James D. Lacey & Co., New York, from 1917 to 1932 and since then has engaged in private consulting work and as an advisor in forest economics.

Mr. Sterling became a member of the Society of American Foresters in 1903 and was elected Fellow in 1953. He was past president of the American Wood Preserver's Association and member and past director of the American Forestry Association, American Pulpwood Association, and the Southern Pulpwood Conservation Association. During his professional career he was responsible for the inauguration of good forest management practices in hundreds of thousands of acres of forest land.

Reviews

The Oxford System of Decimal Classification for Forestry

Prepared by Commonwealth Forestry Bureau. 115 pp. Published by Commonwealth Agricultural Bureaux, Farnham Royal, England. 1954. 10 shillings.

Two professional groups receive the publication of the Oxford System with gratitude: foresters, who appreciate its logical and inclusive analysis of their subject field; and librarians, some of whom feel that forestry has been a neglected subject in classification. This review will attempt to summarize the publication from the viewpoints of both professions.

As a project of the Joint FAO/IUFRO Committee on Bibliography, the Oxford System is essentially a product "of foresters, by foresters, and for foresters." Its final issuance results from a series of meetings of European and American foresters, from 1949 to 1953. The work of reconciling and systematizing the divergent contributions of these professional men largely fell upon Mr. Percy Beak, of the Commonwealth Forestry Bureau, Oxford. This was an auspicious event, due to Mr. Beak's extensive experience as a documentalist with *Forestry Abstracts*. The results are a tribute to his patient nature and orderly mind.

FAO/IUFRO recommend that the Oxford System be adopted in forestry documentation centers of member nations. Its use for classifying book collections, pamphlet files, and even photographs presents attractive possibilities. Considerable manipulation and adaptation of the System can be made by using only those divisions and subdivisions which apply to the collection at hand.

The conspectus of primary headings shows nine main divisions, in the classic decimal tradition. The first class is 0. Forests, Forestry, and Utilization of Forest Products, a class to be used sparingly, chiefly auxiliary to other class numbers. Class 1, Factors of Environment. Biology, includes those aspects of soils, meteorology, hydrology, and ecology, which some previous forestry classifications have neglected. Class 2, Silviculture, is thoroughly done, with over 300 headings and subdivisions, as one might expect from the Continental foresters who conceived it. Class 3, Work Science. Harvest. Engineering, includes some of those aspects of forestry most difficult to classify by older schemes. It seems well worked out. Class 4, Forest Injuries and Protection, is the least complex section. This usually has been the case in other forestry classifications. Again, in Class 5, Forest Mensuration, we have demonstrated the thoroughgoing technical analysis which we might expect of our European confrères. This class includes a section on aerial reconnaisance and survey.

Class 6, Forest Management, is traditionally rocky ground in forestry classification. However, by adhering closely to the European concept of forest management (which I always think of as a "tight" one, as against our "loose" one), Class 6 comes off rather well. It includes the business economics of forestry, working plans, and the administration and organization of forestry enterprises.

Class 7, Marketing and Economics of Industries, is highly complex and somewhat uncohesive, reflecting, perhaps, the nature of the subjects. The class is a sort of catch-all, for prices, trade, product-transport, and accounting. In Class 8, Forest Products and Their Utilization, the ingenious shapers of the Oxford System have enfolded what we call "wood technology," including anatomy and properties; conversion processes for all products; seasoning and preservation; pulp and paper technology; and that final, inevitable section, Other Forest Products. Class 9 covers forestry from the national point of view, including the broad social and economic implications of the subject often difficult to classify. It contains forest policy, taxation, labor, and the international aspects of conservation.

Anyone considering the adoption of the Oxford System should read carefully its introduction, pp. 4-10. Such a reading is certainly required for Americans considering it. The complexities of classed-catalog number assignment, and classed-catalog filing, are foreign to most of us. However, some honest concentration, and a bit of extraneous doodling, should bring matters clear in a short time.

The System is supplemented by auxiliary subject numbers for geographic and taxonomic subdivisions, and by an excellent subject index. In any practical use of the scheme, the index is as essential as an understanding of the introduction.

Among American foresters, in both private and public employ, two objections to the Oxford System have been raised. These are, (1) "It is too complex. We want a simple system which our file clerk can handle," and (2) "The terminology is stilted. What American forester refers to 'husbandry' or to 'brashing'?" In answer to the first objection, it should be pointed out that this System is a first-quality product. A library, or set of research files, whether large or small, destined for first-quality use, deserves a classification system which is thoroughly professional in scope and detail. The entire Oxford System need not be used, in every case, as has been pointed out; only those divisions and headings which apply. In addition, any first-quality library or file requires a person behind it who is equipped by training and temperament to cope with a professional problem on a professional level. Such a person receives a commensurate salary. Hence, American executives considering it should realize that the

Oxford System is not for the understaffed, undermanned, underbudgeted office or library.

To the second objection, the reply is, that beyond a few instances, the terminology of the Oxford System is remarkably universal. A reading of the FAO/IUFRO Joint Committee proceedings shows that the contribution of American foresters attending the meetings was practically nil. The time for bringing out our own vagaries and preferences was at those meetings. This was not done. Despite this neglect, we have fallen heir, so to speak, to an applicable and useful scheme.

The publication of the Oxford System happens to come at a time when the American library profession is re-evaluating the subject of classification as a whole. Librarians are mindful of the shortcomings of expandable-to-infinity classification schemes. They know, from wistful experience, that no scheme can be all things to all persons on all occasions. They also are mindful that one of America's greatest contributions to library science (other than the Dewey Decimal System) is the dictionary word-catalog. Most of our established forestry documentation centers use the dictionary catalog. The Oxford System is designed to accompany, and to create, a classed number-catalog, in the European tradition. Therefore, the American librarian is going to ponder a bit over the economics, and indeed, the logic (as there is no proof that the classed-catalog is superior to the dictionary catalog as an information tool) of converting to the Oxford System. However, the librarian does respond with interest to the idea of a *new* documentation center's trying the System, or to the notion of keeping an auxiliary file of the Imperial Forestry Institute's catalog, classified by the Oxford System.

There are many other aspects of this scheme to engage the thoughts of foresters and librarians alike. It would take a complete issue of the JOURNAL to elaborate them. Perhaps it is best to close, simply by saying "Thank you and well done," to FAO/IUFRO, and to the Commonwealth Forestry Bureau.

FRANCES FLICK
U.S. Dept. of Agriculture Library

The Forests of Cuba

By Earl E. Smith. 98 pp. Illus. Maria Moors Cabot Foundation, Harvard University, Petersham, Mass. 1954

Two summer surveys, a year's residence for observations, and some 15,000 miles travel by jeep, helicopter, mule, and afoot have enabled the author to present a comprehensive picture of existing Cuban forests. He states his objective as "a study undertaken to provide a body of information on the forests of Cuba so that future workers will have a starting point in planning management programs." While the study is primarily one of descriptive plant geography concerned with distribution and present state of the forests, it has been necessary to consider the pressing economic situation that is rapidly eliminating the forest from many areas.

Prior to Columbus, Cuba's 44,000 square miles were at least 60 percent forested. Over the next 400 years (1492-1902) land clearing advanced little beyond the larger towns, and the forests were little changed in size or content. Then, after the American occupation, and under the subsequent republic, the raising of sugar cane became vastly more profitable, and the clearing of forests increased. Today, about 15 percent of the island supports some forest, but it is a relatively poor, understocked remnant.

The population, largely agricultural, has increased from 1.5 million in 1899 to 5.2 million in 1950. Cuba has no native coal or oil so that, with the population pressure for more land for cultivation, the forests face an insupportable demand for products, especially wood for fuel.

Dr. Smith presents by description, tables, maps, and photographs an inventory of the location, composition, and condition of the existing forests. His classification of forest types is based primarily on soils, and thus secondarily on "effective" rainfall, two criteria that fit especially well the maze of tropic tree species.

He has identified and described the living conditions of 4 species of pine and some 200 species of tropic hardwoods. These descriptions are of value to foresters throughout the Caribbean since on many of the islands the associations and combination of species found by Smith in Cuba have long since disappeared.

The author closes with recommendations for further studies looking to the rehabilitation of existing forests and to the development of plantations of fast-growing exotics. Importation is relieving the current shortage of timber supplies, but home supplies are clearly indicated.

H. B. BOSWORTH
Tropical Forest Experiment Station

Principles of Log Measurement

C. F. Laver. 200 pp. Illus. John de Graff, Inc. New York 10, N. Y. 1954. $2.50

American and Canadian foresters currently enmeshed in the inadequacies of the board foot as a basic unit of measurement will be sympathetically interested in the anomalies of cubic measurement which our British friends have evolved during the past 300 years.

Laver has prepared an excellent treatise, copiously illustrated with diagrams and examples. The conventional methods of log measurement in the United Kingdom are presented against a mathematical background in order to determine their relationship with true volume. Such a book will be useful as a text for students and those in the timber trade. For those interested in foreign export or British forestry, it will serve as a handy reference work.

The *imperial standard cubic foot*, the *Hoppus foot*, the *caliper foot*, and the *tape foot* are four units of

log measurement in common use. The *Hoppus foot* is 1.2732 larger than the standard cubic foot, and the others fluctuate around the standard cubic foot depending on the shape of the timber or log. The *standard*, the *load*, and the *parcel* are used to express the volume of piles of squared timbers or logs. Of these only the *standard* (165 cubic feet) bears a constant relationship to one of the basic units.

Log lengths are measured to the foot or half-foot with linen or steel tapes. Diameters or round logs and the width and thickness of large timbers or partially sawed logs are measured with tapes and bow or bea calipers to the quarter-inch. Quarter-girth measurements, one-quarter of the circumference of a log, are generally made with a quarter-girth tape to the quarter-inch. These measurements, which are comparatively precise according to American standards, yield results that vary considerably from one another according to the basic cubic form employed. There are many examples to make these variations stand out.

Laver states that "Rising prices commonly exercise a tonic influence upon methods of measure; making them more equitable by increasing their accuracy." Following his discussion of the limitations of many current practices, he concludes that "Measurers will not in many cases have the freedom to make radical changes in the established practices of the undertakings or authorities to which are attached; and managers and others who possess that power are apt to use it sparingly." Thereupon he makes a series of suggestions that will improve log measurements within the present structure.

In conclusion, he forecasts the future of British log measurements with a strong indication that the board foot will be the principal, if not the sole, unit of square log measure in the United Kingdom, and that standard measure will be used for round logs. Perhaps it would be well for Mr. Laver to investigate the American literature on the board foot and its anomalies with a view towards revising his forecast.

HAROLD E. YOUNG
University of Maine

Fire Fighter

By Mark Boesch,. 187 pp. William Morrow and Company, Inc., New York 16, N. Y. 1954. $2.75.

Steve Dalton, age 17, went West from Ohio to grow to manhood and gain confidence in himself. Chance took him up the Bitterroot Valley in Montana and two days later he was fighting fire for the Forest Service.

Steve is a likeable lad, and boys his age and younger will share and enjoy his adventures. Bart McCully, the ranger, took to him from the start. His friendship with Red Anderson, the sector boss, stemmed from their swim together in the numbingly cold, mountain stream after the first day on the fire line. Steve's interest and ability on the job won him employment the rest of the summer on Red's trail crew.

With the summer nearly spent, Steve wondered whether to go to forestry school as Bart suggested or to accept Red's offer of partnership in trapping martin—Red's perennial, winter vocation. The decision made, he and Red trapped 120 pelts that winter, with the boy banking his share for school next fall. Along the trap line the techniques of shooting, trapping, snowshoeing, and even the conservation of game are woven into the story in an interesting manner.

The second summer Steve manned Thunder Mountain Lookout with some distinction. He sighted, then smokechased an acre fire and brought it under control. When, on the same trip, a lightning strike made a torch of a tall pine, he brought the 40-inch tree to earth with a pulaski. After licking not one but two fires that night, he filled out the report forms and headed back to his tower. The story ends with Steve's planning to attend forestry school that fall. Foresters might welcome seeing Steve again in a sequel, recognizing the desirability that boys read forestry stories with the facts pretty well in focus.

Mark Boesch, the author, a fire dispatcher on the Bitterroot National Forest, lives at Hamilton, Montana. He too came from Ohio originally, but his story is not autobiographical. Beginning work for the Forest Service in Montana in 1939, he gained the background experience about which he writes from his service as smokechaser, trailworker, and lookout man. Not a novice at writing, he has written two other juveniles, both historical books, and published magazine fiction and articles, principally on history and the outdoors.

Fire Fighter succeeds in what the author intends by giving the maturing boy a factual glimpse of several aspects of subprofessional work with the Forest Service. It is no tale of implausible adventure; the situations, characters, descriptions, pleasures, and dangers are kept in modest and credulous proportions. The author has done forestry a service in holding to realism. For this reason, especially, the book is recommended to high school libraries, Boy Scout clubrooms, and individual boys who would like authentic information about some types of seasonal work with the Forest Service. The inspirational tone seems to be adequately camouflaged.

BEN HUEY

The Flood Control Controversy.

By Luna B. Leopold and Thomas Maddock, Jr. 278 pp Ronald Press Co., New York. 1954. $5.

This important book explores the flood control programs of the Corps of Engineers and the Department of Agriculture. These programs differ in the lands to be protected from floods as well as the methods for achieving the protection. The Corps of Engineers has been responsible for protecting developments along the larger rivers while the Department of Agriculture program is intended to protect the

lands along the small tributaries from local floods.

The authors appraise downstream and upstream flood control problems and remedial programs and discuss engineering and land management measures. To some readers, it may appear that problems of the midwestern states receive too much attention and that there is little or no attention to the role of wild land management in flood control.

The importance of engineering measures in the current program of the Department of Agriculture will be a surprise to many. Retarding dams are now a major part of the program and the reservoirs formed are small only when compared with a really large dam. The average dam proposed is 50 feet high and impounds a permanent pool covering 50 acres. When filled to spillway level the area covered by water is 200 acres.

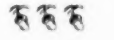
The need for more research to determine better land management systems and to evaluate the role of land management in flood control is emphasized. The most serious deficiency is the lack of information relating to the vast area of grazing land below the national forests. The Forest Service is commended for its sustained research program in wild land management. The Department of Agriculture is criticized for making only minor use of the experimental results from watershed experiments in developing its flood control programs.

The authors are also critical of the confounding of flood control measures with practices for improving productivity in the Department of Agriculture programs. The Department's estimates of the benefits from current programs show that 90 percent of the expected benefits are claimed for increased yields of crops, pasture, and timber. Flood control benefits, such as prevention of inundation and sedimentation, are only 10 percent of the total benefits.

Past works and current programs of the Corps of Engineers are discussed with critical scrutiny. The authors believe that the limitations of the downstream program have not been sufficiently explained to the public, and that flood plain zoning and flood insurance should become part of the flood control program. Flood plain zoning would prevent developments in areas where protection is difficult or possible only at large public expense while flood insurance offers a way of ameliorating the impact of floods.

The authors and their sponsors, the Conservation Foundation, deserve praise for this book which is recommended reading. The appraisals, while sometimes biting, appear to be impartial. While foresters will be disappointed because wild land management is not discussed, they should be cheered that management of wild lands is not a part of the present day flood control controversy.

MARVIN D. HOOVER



Wire Skidding: Wood Transportation by Gravity Over a Suspended Wire.

By A. Koroleff and R. D. Collier. 137 pp. Illus. McGill University Book Store, Montreal, P. Q., Canada. 1954. $2.

Loggers and pulpwood producers are well aware of the transport difficulties presented when operating steep slopes. Because of the high cost of customary transportation practices, such as sluicing, horse skidding, and hand pitching, large quantites of merchantable timber have heretofore been considered commercially inaccessible.

In view of the increasing demand for forest products it becomes important that the so-called areas of difficult operation be brought into production. A comprehensive and detailed report is now available which holds a solution to many of the problems involved in logging on steep slopes. By harnessing the force of gravity, wire skidding offers what appears to be an effective technique for use by the large as well as small independent operator.

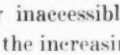
This very competent report by Alex Koroleff and Robert Collier concludes a project on wire skidding at the Pulp and Paper Research Institute of Canada. It covers in great detail the techniques of wire skidding, equipment employed, production rates and costs. The book discusses research in multiple-span wire skidding and concludes with an evaluation of its advantages, limitations, and potentialities.

Some of the benefits to be remarked include the automatic descent of wood by use of the force of gravity; simple, inexpensive, portable equipment; reduction in wood waste and protection of shallow soils on steep slopes from erosion.

Limitations noted are that wire skidding is restricted to ground profiles that permit the load to clear the ground. Single spans up to 1500 feet have been used, but the maximum distance has not yet been established; "though the method is simple, thorough understanding of the correct technique is essential for its successful introduction into commercial logging" and suitable wire should be chosen by a competent agency.

The appendices to the book serve to clarify certain technical references in the text. It is certainly worthwhile reading for pulpmen with stands on rough and steep terrain. Just as aerial tramways have revolutionized the skiing business, wire-skidding may considerably change a not much investigated section of the wood industry, prohibited to loggers because of topographic and economic reason.

WILLIAM H. DEROSIER
American Pulpwood Association



Papers Presented at Fiftieth Anniversary Celebration

Forestry Department Golden Anniversary 1903-1953. 92 pp. University of Maine, Orono, Maine. 1954. $2.

The golden anniversary meeting of the Forestry Department of the University of Maine was held at Orono, October 1, 2, and 3, 1953.

This publication, which contains the papers presented at this meeting, reviews not only the development of forestry education but all other forestry activities in Maine.

The theme of the meeting was "The Role of Forestry in the Development and Future of Maine."

The session on forestry education featured three stimulating and interesting papers: one, a review of the fifty years of forestry instruction at Maine by Robert I. Ashman; two, a description of the development of forestry within the College of Agriculture by Dean Arthur L. Deering; and three, a summary of education and research in forestry by George A. Garratt.

In the technical session under the chairmanship of D. B. Demeritt, three well-known citizens of Maine presented papers on forest land management. Louis J. Freedman discussed timberland management in the pulpwood industry; R. Leon Williams discussed timberland management on small holdings; and Albert D. Nutting reviewed the organization, functions, and contributions of the Maine Forest Service.

The session on hardwood and long lumber industries was under the chairmanship of George D. Carlisle. John W. Tebbets described hardwood's place in the Maine economy. Kenneth Hancock gave an analysis of the raw material requirements of the softwood lumber industry, present and future.

The session on contributions of research to forestry was covered by three papers under the chairmanship of Allen W. Bratton. V. L. Harper described how research can contribute to better forest land management with examples from the spruce-fir region. Robert J. Seidl discussed the relation of utilization to forest management. W. S. Bromley reported on the development of logging research in this country and its importance to the future of the State of Maine.

Ralph T. King discussed the integration of wildlife and forest land management in the northeast. The concluding paper was by Laurence Whittemore, president, Brown Company, on the role of forestry in the future development of Maine.

The publication includes a brief description of the University of Maine Forest, the Penobscot Experimental Forest, and the State Forest Nursery. Citations of honorary degrees presented to Hon. Douglas McKay, Dwight B. Demeritt, and Louis J. Freedman are included in addition to the remarks by Mr. McKay at the University Convocation.

The Forestry Department of the University of Maine is to be congratulated for publishing the interesting contributions of the individuals who presented papers at this meeting. One cannot help but gain a greater respect for his profession after studying these papers. This publication must be read by foresters and students alike who are interested in the development of forestry education, research, management, utilization, and other aspects of forestry in the Pine Tree State.

MAURICE K. GODDARD
Pennsylvania State University

Publications of Interest

A Simple Test of Stereoscopic Perception is Technical Paper No. 144 of the Central States Forest Experiment Station, Columbus, Ohio. It will save instructors and students in photo interpretation a lot of potentially lost time by making it possible to quickly test an individual's stereo perception with no equipment other than the lens stereoscope.

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Small Engines Service Manual is a new publication covering the service and repair of some 150 different models of air cooled engines. Factory data and approved shop methods are presented in condensed, uniform style for quick reference. Available at $2.95 from Implement and Tractor Publications, Inc., Graphic Arts Bldg., Kansas City 5, Mo.

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The June 1954 issue of *Photogrammetric Engineering* (Volume XX Number 3) contains a considerable volume of material of interest to foresters including a panel discussion of photo interpretation, a summary by Douglas Kendall of the ways in which aerial photography can save money in forestry work, and a detailed history of forest photogrammetry and mapping by Stephen H. Spurr. Single copies of the issue may be obtained at $1.75 each from the American Society of Photogrammetry, 1000 - 11th St. N. W., Washington 1, D. C.

The *Shenandoah National Park Tourist Survey* is a report prepared and published by the Virginia Department of Highways based on data obtained from a tourist survey conducted by the State in cooperation with the Bureau of Public Roads and the National Park Service at Shenandoah National Park, Virginia, 1952.

Shenandoah National Park was established to preserve an outstanding portion of the Blue Ridge Mountains of Virginia for use and enjoyment by the people. The appeal of the Park and its acceptance by the public is evidenced by the tremendous growth in the number of visitors. Also contributing to the increased usage are the improvements that have been effected in the highway system and motor transportation, making the Park readily accessible to vast numbers of people.

The tourist survey reveals that the beneficial effects of park use are not confined to the visitor. The attractions of the Park, its lure, accessibility and use also have an economic value that is of particular benefit to the travel industry. The reported expenditure of some $13,000,000 in Virginia alone by visitors to Shenandoah National Park in 1953, provides an indication of the economic benefits of park travel.

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Films available for loan from the U. S. Forest Service, Washington or regional offices include: *Rainbow Valley* (The Story of a Forest Ranger), 28 minute sound film, released 1954, 16-mm Kodachrome, black and white, cleared for television. This picture portrays the work and responsibilities of a U.S.F.S. forest ranger, illustrates the activities in which he engages, and shows the multiple benefits of the national forests. *Horse Sense*, is a training film for service employees whose work puts them in the saddle. Safe handling and proper care of horses are stressed. This film won the award of merit in the 1954 safety film contest of the National Safety Council. It is a 23-minute sound film, in 16-mm Kodachrome, cleared for television.

For purchase information, write to the U. S. Dept. of Agriculture, Motion Picture Service, Washington 25, D. C.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University of New York College of Forestry*
Range Management Section Compiled by FRANCES FLICK, *Library, U. S. Department of Agriculture*

General

Eastern White Pine. By H. S. Betts. 8 pp. U. S. Forest Serv., Washington 25, D. C. rev. 1954. American Woods. 5 cents (Govt. print. off.)

An Introduction to Trees. ("A book for beginners") By John Kieran. 77 pp. Illus. Hanover House, New York. 1954. $2.95.

Lookout Wife. By J. K. Beaty. 311 pp. Random House, New York 22. 1953. $3.50.

Mid-Century Alaska. 155 pp. Illus. U. S. Dept. of the Interior, Washington 25, D. C. 1954. 75 cents (Govt. print. off.)

The New Tree Experts Manual, 2d ed. By R. R. Fenska. 238 pp. Illus. De la Mare Co., New York. 1954. $5.00.

Western White Pine. 6 pp. U. S. Forest Serv., Washington 25, D. C. rev. 1954. American Woods. 5 cents (Govt. print. off.)

Forest Products

Gum Flow and Pitch-Soak in Virginia Pine Following Fusarium Inoculation. By G. H. Hepting. 8 pp. Illus. Southeastern Forest Expt. Sta., Asheville, N. C. 1954. Station Paper No. 40. Mimeog.

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Applied Forest Management. By P. E. Bruns. 383 pp. Illus. Publ. by author, Missoula, Mont. 119 Mount Ave. 1954. $5.00.

Revised Yield Tables for Conifers in Great Britain. By F. C. Hummel and J. Christie. 23 pp. Great Britain Forestry Commission, London. 1953. Forest Record No. 24. 1s. 3d.

Volume Table for Small Hardwood Trees. By J. N. R. Jeffers. Great Britain Forestry Commission, London. 1954. Forest Record No. 28. 9d.

Logging and Milling

Enmansmotorsågens Lönsamhet några Undersökningsresultat. (The Economics of the One-Man Power-Saw) Summary in English. By Greger Carpelan. pp. 499-582. Föreningen Skogsarbetens och Kungl. Domänstyrelsens Arbetsstudieavdelning, Stockholm. 1954. Meddelande N:r 49.

Power Chain Saws; Selection and Maintenance. By F. C. Simmons. 16 pp. Illus. [Northeastern Forest Expt. Sta., Upper Darby] 1954.

Statistical Record of the Logging Industry and Summary of the Forest Industries in British Columbia. Part II, Sect. I. By J. T. B. Kingston. 54 pp. Bureau of Economics and Statistics, Dept. of Trade and Industry, Victoria, B. C. 1954. Mimeog.

This Was Logging. By R. W. Andrews. Illus. Superior Publ. Co., Seattle 11. Box 2190. Fall, 1954. $8.50.

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Drought Crack of Conifers. By W. R. Day. 40 pp. Illus. Great Britain Forestry Commission, London. 1954. Forest Record No. 26. 2s. 6d.

Forest Diseases and Insects of Georgia's Trees. By L. W. R. Jackson. 40 pp. Illus. Georgia Forestry Commission, Atlanta. 1954. Free.

Prevention of Decay of Wood in Boats. By J. G. Savory with a Contribution on Electrochemical Attack by D. F. Packman. 18 pp. Illus. Great Britain Dept. of Scient. and Indus. Research, London. 1954. Forest Products Research Bul. No. 31. 2s (H. M. Sta. off.)

Protection

Fires in the State Forests in the Years 1929-1952. By H. Charters. 31 pp. Great Forestry Forestry Commission, London. 1954. Forest Record No. 23. 1s. 6d.

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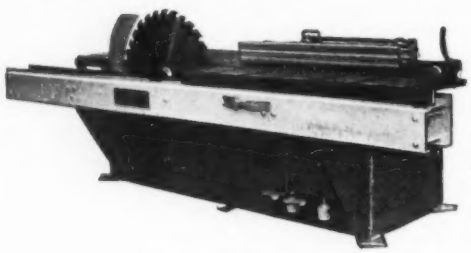

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September 10, 1954.

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JOURNAL OF FORESTRY
Gentlemen:

The September issue of the JOURNAL OF FORESTRY is excellent. Congratulations on a job well done. The information contained is timely and very much needed by progressive forest land managers. As more and more of our lands are restocked by planting or seeding, genetics play an increasingly important part in long range plans designed to improve timber quality and increase timber growth.

The issue should be of interest to all foresters, while it focuses attention on a comparatively new field of management activities in the United States. I, for one, certainly appreciate the information presented in the issue and plan to incorporate the data in our management planning.

Yours very truly,

L. T. WEBSTER
Supervisor of Forestry
DONALD R. HOPKINS
Asst. Supervisor-Management

The President's Column

Our Society does not claim any corner on ideas or actions leading to the progress of forestry in America. Although one of the Society objectives since we organized in 1900 has been "to promote the science, practice, and standards of forestry in America," we should welcome and encourage any efforts made along that line by any other group or agency.

It is timely, therefore, to recognize and commend the recent action taken by the American Forestry Association in its formulation and adoption of a detailed program for American forestry. That Association was organized in 1875, and through the years has continued to bring to the attention of the public information on conservation of forests, through its monthly magazine *American Forests* and through periodic forestry congresses, the fourth and most recent of which was held in Washington, D. C., in October 1953.

As might be expected, several members of our Society serve the American Forestry Association as officers and on the Board of Directors, of which I happen to be a member. The annual meetings of this Association have brought nontechnical discussions of forestry matters into many parts of the United States, the most recent meeting having been held in Portland, Oregon, in early September. It was my good fortune to have had the opportunity of attending this meeting where I was favorably impressed with the program and the educational field tours arranged by the local committee.

Let me urge each of our members to obtain and study a copy of the *AFA*'s program for American forestry, which is available from the Association headquarters in Washington, D. C. This program has received the overwhelming endorsement of the Association's membership, now totaling around 25,000.

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(1) to meet the essentials of forest protection, (2) to improve the national timber crop in volume and quality to a degree sufficient to wipe out all deficits and build up a reserve, and (3) to obtain the maximum of economic and social services from our forests by realistic application of the principles of multiple use in their management.

Certainly, none can quarrel with these goals. How they can best be attained leaves room for differences of opinion, but this is the American way of arriving at a goal. Although some may not agree on all the details, to me it seems worthwhile to study this program and to help promote it to the extent that it conforms with Society policies and objectives.

The program has been divided into five major headings: (1) forest land ownership, (2) forest land management, (3) multiple use policies, (4) education and assistance to forest owners, and (5) forest research and surveys. Each of these topics is discussed briefly and specific recommendations are made as to how best to reach the various goals.

Personally, I think we should commend the *AFA* for its vision and labor, which have resulted in the forward-looking program; and we should wish it well in these efforts to benefit America's forests and thus all Americans.

E. L. Demmon

Columbia River and Puget Sound Sections Host to A.F.A.

The Columbia River and Puget Sound Sections were hosts to members of the American Forestry Association at a joint section meeting held at Portland's Multnomah Hotel on September 8th. Total attendance was 206. The A.F.A. were members attending that Association's 79th annual meeting, being held for the first time west of the Mississippi River.

The meeting was jointly toastmastered by Lloyd Hayes and Don Hopkins, chairman of the Columbia River and Puget Sound Sections respectively. The growth in employment of professional foresters and in Society membership in the Northwest were outlined. The two sections now contain 15 percent of the entire S.A.F. membership.

S.A.F. Council members presented were Ed Heacox, J. Herbert Stone, Stanley Fontanna, and Vice-President De Witt "Swede" Nelson. Introductions were made of former S.A.F. President Clyde Martin and the current president of the American Forestry Association, Don P. Johnston.

President E. L. Demmon, after telling of his early work in the west for a lumber company in Eastern Oregon, planting of the Hebo Burn and of surveying in the Wallowa Forest, told of current efforts to increase S.A.F. membership; he spoke of the progress to-

NEWLY ELECTED OFFICERS of the Puget Sound Section of the Society of American Foresters lay plans for the coming year. Left to right: Chairman Donald R. Hopkins, Washington State Division of Forestry; Vice-chairman Douglas C. Welch, Puget Sound Plywood Co.; and Secretary-treasurer Royce Cornelius, Weyerhaeuser Timber Co. Retiring Section chairman is Edwin C. Loners, U. S. Forest Service. Also active in the Puget Sound Section are two chapters. North Olympic chapter chairman is C. J. Hopkins of Peninsula Plywood Corporation. Chairman of the Southwest Chapter is Elmer W. Shaw, U. S. Forest Service.

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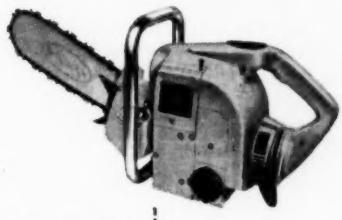

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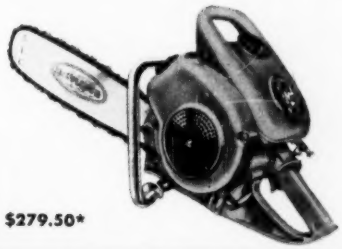

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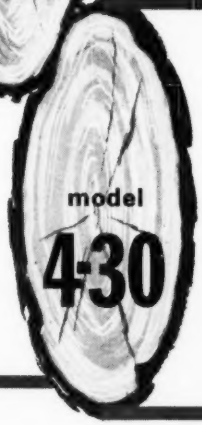

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ward printing the *Foresters Manual* and the report on forestry research.

Congressman Harris Ellsworth of Roseburg, Oregon, gave the principal address of the evening on "The Role of Forestry in the Pacific Northwest."

ARTHUR W. HOLMES
Secretary-Treasurer,
Portland Chapter.

New England Section Meeting

The summer field meeting of the New England Section was held in New Hampshire September 16 and 17. The theme of the meeting was "Private Forestry in Action."

On Thursday, September 16, the foresters inspected five separate woodlots in the vicinity of Lake Winnipesauke. That evening, there was a barbeque at Winnipesauke Yacht Club. The members were welcomed by Bertram Husch, chairman of the Granite State Chapter. Door prizes were presented by Robert S. Monahan. There was discussion of Section business by William P. House, chairman, and a report on national Society business by Henry Clepper, executive secretary. A summary of the day's excursion was given by Dr. Hugh Raup of Harvard Forest.

On Friday, September 17, a visit was made to the Storer Forest at Strafford where T. L. Storer, manager of the 4,000-acre tract, was host to the members at a picnic luncheon at Willy Pond. Donald R. Poppema, resident forester of the Storer property, led the party on a field trip to various plantations and thinning operations.

By action of the Executive Committee of the Section, the Council of the Society was invited to hold the Society's annual meeting in Boston in 1957, jointly with the Canadian Institute of Forestry.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatement received in the Society office during the month of September are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of December 1, 1954. Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

UNIVERSITY OF WEST VIRGINIA

Hartman, D. W. — Wilson, G. N.
Phares, R. E. — Wimer, J. W.
Weller, D. G.

Junior Grade

Zurbuch, P. E., 2121 Main Street, Wellsburg, W. Va.; W. Va. Univ., B.S.F., 1953.

Students Eligible for Automatic Advancement

PENNSYLVANIA STATE UNIVERSITY

Eyster, R. E. — Miller, W. F.
Fox, J. F. — Reynolds, T. A.
Frank, R. M. — Sorokach, M. R.
Kocjancic, E. F. — Vogel, V. R.

WEST VIRGINIA UNIVERSITY

Angatti, J. — Swatzyna, R. J.
Ruckel, J. M.

Appalachian Section

Junior Grade

Bishop, R. Q., Consulting Forester, Bishop Bros., Florence, S. C.; N. C. State, B.S.F., 1949.

Students Eligible for Automatic Advancement

DUKE UNIVERSITY

Bilan, M. V.

Affiliate Grade

Porter, M. G., Forestry Aide, Camp Mfg. Co., Franklin, Va.; V.P.I., B.S., (Forestry), 1953.

Central Rocky Mountain Section

Student Grade

COLORADO A & M COLLEGE

Chappelle, D. E.

Students Eligible for Automatic Advancement

COLORADO A & M COLLEGE

Zipse, R. E.

Central States

Junior Grade

Munger, R. J., Farm Forester, Ohio Div. of Forestry, Dover, Ohio; Iowa State, B.S.F., 1948. Reinstatement.

Students Eligible for Automatic Advancement

PURDUE UNIVERSITY

Carlson, W. D. — Rhoda, C. F.

Member Grade

Berry, F. W., Wood Tech., Brunswick, Balke, & Collender, Muskegon, Mich. (Junior, 1946).
Frescoln, J. W., 1138½ S. Roosevelt Ave., Piqua, Ohio. (Junior, 1947).
Philbrick, A. R., Dist. Forester, Ogemaw State Forest, West Branch, Mich. (Junior, 1947.)
Schaap, G. M., 1321 W. Holmes Rd., Lansing, Mich. (Junior, 1947).
Walker, F. R., 1007 Douglas Ave., Elgin, Illinois. (Junior 46R50).

Affiliate Grade

Black, J. E., Ranger, Ohio Div. of Forestry, Friendship, Ohio.

Columbia River Section

Junior Grade

Gartman, J. L., Asst. Forester, Elk Lbr. Co., Medford, Ore.; State Univ. of N. Y., B.S.F., 1949.

Students Eligible for Automatic Advancement

OREGON STATE COLLEGE

Armstrong, L. G.

Affiliate Grade

Moltke, R. I., Logging Supt., Pilot Rock Lbr. Co., Pilot Rock, Ore.

Gulf States Section

Junior Grade

Students Eligible for Automatic Advancement

LOUISIANA STATE UNIVERSITY

Lee, B.

Affiliate Grade

Day, C. C., Part Owner & Mgr., The Day Co., Columbus, Miss.
James, T. W., Forester, A. J. Hodges Inds. Inc., Many, La.
Martin, N. K., Forester, Roy O. Martin Lbr. Co., Alexandria, La.

Inland Empire Section

Junior Grade

Carlson, M. R., Forestry Spec., U.S.D.A., Moscow, Idaho; Univ. of Idaho, B.S.F., 1941.

New England Section

Junior Grade

Students Eligible for Automatic Advancement

UNIVERSITY OF MAINE

Sabotis, C. J. — Thomas, C. S.
Simm, B. K. — Yates, H. O.

New York Section

Junior Grade

Terrell, E. G., Forester, N. Y. State Cons. Dept., Catskill, N. Y.; State Univ. of N. Y., B.S.F., 1950.

Students Eligible for Automatic Advancement

STATE UNIVERSITY OF NEW YORK
McKenzie, T. A. Tremper, E. O.
Schultz, R. J. Valantine, M. F.

Member Grade

Rankin, D. G., Supt., N. Y. Cons. Dept., Albany, N. Y.; State Univ. of N. Y., B.S.F., 1923. Reinstatement.

Ozark Section

Junior Grade

Students Eligible for Automatic Advancement

UNIVERSITY OF MISSOURI
Ryker, R. A.

Affiliate Grade

Roberds, R. C., Supv. Forestry Aide, U.S.F.S., Waldron, Ark.
Swiger, D. E., Forestry Aide, U.S.F.S., Hot Springs, Ark.

Puget Sound Section

Junior Grade

Swartzlender, R. D., Forest Eng., U.S.F.S., Olympia, Washington; Ore. State, B.S.F., 1948.

Students Eligible for Automatic Advancement

UNIVERSITY OF WASHINGTON
Anderson, H. W. Olson, O. E.
Fredriksen, R. L.

Southeastern Section

Junior Grade

George, J. L., Tbr. Cruiser, International Paper Co., St. Augustine, Fla.; Univ. of Fla., B.S.F., 1952.
Haas, C. W., Forest Tech., International Paper Co., Ponce de Leon, Fla.; Penn. State, B.S.F., 1940.
Howard, E. R., Dist. Forester, Fla. Forest Service, Panama City, Fla.; Univ. of Fla., B.S.F., 1949. Reinstatement.
Liddon, M. E., Tree Surgeon, Univ. of Fla., Gainesville, Fla.; Univ. of Fla., B.S.F., 1952.
Morris, G. S., Forester, Buckeye Cellulose Corp., Perry, Fla.; L.S.U., B.S.F., 1951; M.F., 1952. Reinstatement.
Phillips, L. L., Mgr., Soperton Gum Market, Soperton, Ga.; Univ. of Ga., B.S.F., 1949.
Ryder, J. D., Forester, Union Bag & Paper Co., Pooler, Ga.; Univ. of Ga., B.S.F., 1951. Reinstatement.
Waters, W. V., Consulting Forester, Mt. Vernon, Ga.; Univ. of Ga., B.S.F., 1938. Reinstatement.

Students Eligible for Automatic Advancement

ALABAMA POLYTECHNIC INSTITUTE
Crutcher, R. P. Thomas, L. W.
Meadows, J. C.

UNIVERSITY OF GEORGIA
Altobellis, A. T. Mudick, N.
Atchison, F. D. Stanford, J. M.
George, W. C. Teate, J. L.
Hicks, J. R. Thompson, J. E.
Holston, G. W. Thompson, L. O.
Jones, L. Wynn, G. F.

Member Grade

Sands, N. E., Woodland Conservationist, U.S.D.A., Waycross, Ga.; Univ. of Ga., B.S.F., 1934. Reinstatement.

Affiliate Grade

Coker, W. H., Dist. Forester, State of Ala., Dadeville, Ala.

Southern California Section

Junior Grade

Grace, H. D., Fire Control Officer, U.S.F.S., Duarte, Calif.; Utah State Agric., B.S.F., 1941. Reinstatement.

Southwestern Section

Junior Grade

Eden, J. M., Chief Ranger, Nat'l. Park Service, Carlsbad, N. Mex. (Affiliate, 1948).

Upper Mississippi Valley Section

Student Grade

IOWA STATE COLLEGE
Andreas, L. G. Johnson, V. A.
Gruening, W. E. Lindquist, L. A.
Jack, L. E. Sweitzer, G. A.

Junior Grade

Anderson, S. H., Ext. Forester, Univ. of Minn., Bemidji, Minn.; Univ. of Minn., B.S.F., 1949.

Students Eligible for Automatic Advancement

IOWA STATE COLLEGE
Schmidt, V. N.

UNIVERSITY OF MINNESOTA
Engelbretson, K. E.

Member Grade

Meyer, J. D., Forester, Minn. Forest Service, Willow River, Minn.; Univ. of Minn., B.S.F., 1949; M.F., 1951. (Junior, 1950).

Associate Grade

Schreiner, K. M., Habitat Dev. Leader, State Game & Fish Dept., Bismarck, N. Dak.; Parsons College, B.S., (Biology), 1950; Iowa State, M.S., (Wildlife Mgmt.), 1951.

Wisconsin-Michigan Section

Junior Grade

Hause, R. H., Dist. Forester, Wm. Bonifas Lbr. Co., Pickford, Mich.; Univ. of Mich., B.S.F., 1947.
McCraney, R. E., Dist. Forester, Wm. Bonifas Lbr. Co., Newberry, Mich.; Univ. of Mich., B.S.F., 1943.

Students Eligible for Automatic Advancement

MICHIGAN STATE COLLEGE
Connelly, J. P. Reynolds, E. J.
East, C. H. Strobel, H. F.
Johnson, J. A. Vorselen, A. L.
Milanowski, N. V.

UNIVERSITY OF MICHIGAN
Cody, J. B. Kelly, M. J.
Dalton, C. B. Montgomery, W. J.
Joye, H. E. Patterson, R. L.

Affiliate Grade

Baer, W. J., Forester, Nekoosa-Edwards Paper Co., Houghton, Mich.; Mich. College of Mining & Tech., B.S., (Forestry), 1952.
Hein, C. E. H., Forester, Calumet & Hecla, Inc., Calumet, Mich.; Mich. College of Mining & Tech., B.S., (Forestry), 1953.
Penberthy, R. J., Foreman, Osmose Wood Preserving, Co., Houghton, Mich.; Mich. College of Mining & Tech., B.S., (Forestry), 1953.

Foreign

Corresponding Grade

Petriceks, J., In Charge of Tech. Office, Venezuelan Forest Service, Caracas, Venezuela.
Wiger, E., Grue Finnskog, Norway.

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Forestry News

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S. T. DANA

A.F.A. Distinguished Service Awards to F. P. Keen and S. T. Dana

The American Forestry Association held its 79th annual convention in Portland, Ore., in September. A large and enthusiastic membership in attendance at this first meeting of the association in the Pacific Northwest heard talks by distinguished leaders and became acquainted with the resources and forestry progress of this great region.

A considerable number of S.A.F. members, including President E. L. Demmon and Vice President "Swede" Nelson, were in attendance and participated in the program. As reported elsewhere in this issue, the Puget Sound and Columbia River Sections of the S.A.F. were hosts to the association at a dinner meeting.

An increasingly prominent feature of the association's annual conventions is the presentation of Distinguished Service Awards to persons whose work in various aspects of the field of conservation warrant national recognition and commendation. Presentation of these awards was made by Robert N. Hoskins, chairman of the Awards Committee, and industrial forester of the Seaboard Air Line Railroad. Of the five men honored in 1954, two are prominent professional foresters, F. P. Keen and S. T. Dana. Recipients of this year's honors are as follows:

General Service: Dr. Olaus Johan Murie, of Moose, Wyo., president of the Wilderness Society, biologist, author, artist, and ecologist. Dr. Murie's many contributions are widely appreciated among conservationists.

Public Servants: Frederick Paul Keen, forest entomologist for the California Forest and Range Experiment Station, U. S. Forest Service, Berkeley, a man "whose sterling accomplishments in the field of forest entomology have won him the plaudits of the whole forestry profession."

Business and Industry: Reuben Buck Robertson, Sr., of Flat Rock, N. C., chairman of the board of the Champion Paper and Fibre Co., "one of the pioneer industrialists whose long, patient, unrelenting interest and participation in better forest management have helped to lay the foundation upon which industrial forestry has attained its present stature."

F. P. KEEN AND R. N. HOSKINS

Public Information: Palmer Hoyt, publisher of the *Denver Post,* widely known and articulate "champion of the American people in the control and management of resources."

Education: Dr. Samuel Trask Dana, of Ann Arbor, Mich., "one of the foremost foresters of our time, a statesman in the field of resources, the creator of Michigan's School of Natural Resources, a Fellow in the Society of American Foresters, pioneering editor of the JOURNAL OF FORESTRY, and a noted author and lecturer."

A Correction

In the September issue of the JOURNAL (page 679) it was erroneously reported that Ralph W. Hayes retired on September 1 as director of the School of Forestry at Louisiana State University. Actually, Professor Hayes resigned the directorship, but retains his professorship and will continue as a member of the faculty carrying on teaching and research.

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Paul Dunn to Join St. Regis Paper Co.

Paul M. Dunn, dean of the School of Forestry, Oregon State College, has accepted the position of technical director with the St. Regis Paper Co. with headquarters in New York City. He will manage the company's technical forestry program involving some 2 million acres of land and will also direct its college scholarship and other forest education projects.

Dunn's 12 years at Oregon State have marked many milestones of progress at the school. His resignation becomes effective January 1.

Forest Science Journal to be Published in 1955

Forest Science, a new quarterly journal of research in forestry, is scheduled to appear early in 1955. It will be launched under the direction of an editorial board of three. Stephen H. Spurr, School of Natural Resources, University of Michigan, Ann Arbor, Mich. is chairman of the board. The other two members are V. L. Harper, assistant chief (for research) of the U.S. Forest Service, and Henry Clepper of the Society of American Foresters, both of Washington, D. C.

Financial aid necessary to start the journal and underwrite its cost for the first three years will be provided from private sources. The three initial cooperating agencies — University of Michigan, U. S. Forest Service, and Society of American Foresters—expect to receive the support of additional cooperators, especially among the colleges and universities.

The participation of the Society will not involve financial outlay, but will consist initially of soliciting subscriptions and maintaining a mailing list of subscribers. The subscription price will probably be $6 annually.

For a more detailed report on this project, readers are referred to the JOURNAL OF FORESTRY for August 1954, page 624. Inquiries about *Forest Science* should be directed to Dr. Spurr, editorial chairman.

Emanuel Fritz Aids History Foundation

Emanuel Fritz, consulting forester of the California Redwood Association, has been named to the national advisory board of the American Forest History Foundation.

The foundation, which has headquarters in St. Paul, Minn., gathers files, records, and documents concerning the American lumber industry and the forestry profession. Fritz, who until recently was professor of forestry at the University of California, will act on behalf of the foundation in locating historical records of the lumber industry which will make its long and important impact on American life and industry available to the public.

California records are to be placed in the Bancroft Library of the University of California at Berkeley.

Aldo Leopold Memorial Dedicated

The late Aldo Leopold was honored September 13 when the U. S. Forest Service and The Wilderness Society joined in dedicating the Aldo Leopold Memorial at a roadside site on Route 260 between Silver City and Glenwood, N. M. The scene was at a point looking toward the Mogollon Mountain range in the vast Gila Wilderness Area which Leopold helped to establish 30 years ago. The Gila Wilderness, com-

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prising more than half a million acres, is a part of the Gila National Forest in southwestern New Mexico and was the first such area established on a national forest.

Leopold, who died of a heart attack on April 21, 1948, while fighting a grass fire near his summer home at Baraboo, Wis., spent a lifetime in the cause of conservation and was a Fellow of the S.A.F. A Yale-trained forester, he served during his early career in the Forest Service in the Southwest. Later he became professor of wildlife management at the University of Wisconsin. His books and teachings in game management, ecology, and land use exerted a wide influence and today are regarded as pioneering. His posthumous book *A Sand County Almanac*, in which he expounded some of his wilderness philosophy, was widely acclaimed.

South-wide Forest Tree Improvement Meetings to be Held

"Accomplishments in Forest Tree Improvement in the South" is the topic to be discussed in the South-wide meeting to be held at Tulane University, New Orleans, on January 5-6, 1955.

Appearing on the program will be Scott Pauley, of the Maria Moore Cabot Foundation; Paul Rudolf, Lake States Forest Experiment Station; Philip Wakeley, Southern Forest Experiment Station; Bruce Zobel, Texas Forest Service; F. I. Righter, Institute of Forest Genetics, Placerville, California; Tom Perry, University of Florida; Francois Mergen, Yale University; E. L. Demmon, director of the Southeastern Forest Experiment Station, and other leaders in tree improvement work.

This is the third South-wide meeting on tree improvement; previous meetings have been held in Atlanta in 1951 and 1953. The Committee on Southern Forest Tree Improvement is sponsoring the meeting.

Philip A. Briegleb, director of the Southern Forest Experiment Station, New Orleans, is in charge of local arrangements.

The meeting is open to foresters, forest landowners, and others interested in forest tree improvement work.

Forest Soils Conference Held

The State University of New York College of Forestry was host to over thirty soils specialists at the Northeastern Forest Soils Conference in the Adirondacks, August 25-27.

Coming from West Virginia, Pennsylvania, Connecticut, Massachusetts, New Hampshire, Vermont, Maine, New York, and the provinces of Ontario and Quebec, the group met at the College's Pack Forest in Warrensburg for registration and a field trip, led by Donald P. White, chairman of the Conference.

After the banquet on the evening of the first day, H. L. Lunt presided over a report and discussion of the planting site committee.

The second day of the conference included field trips to the Mink Pond Area, the College of Forestry's Huntington Forest, the Finch-Pruyn Experimental Forest, the Herman-Wambeck Soils, the Big Brook Burn Areas, and the Fernow Plantations at Waubek Corners.

Walter Lyford and Donald White led the group to all the sites except that of the Fernow Plantations. C. Eugene Farnsworth of the College of Forestry conducted the members through these historic plantations and headed a discussion of historical experiments in conversion from Northern hardwoods to conifers by clear cut-burn-plant technique.

Chairman White presided over a business meeting at Paul Smiths College the same evening, and H. L. Lunt presided over a planting site requirements report.

On the conference's last day, G. M. Twombly and White led a tour through Paul Smiths Forest, the Bay Pond Area, and adjacent locations to demonstrate forest and site changes related to land use history on Adams Soil.

The conference was the seventh annual one for the group which now includes over 100 professional persons in the Northeast including Canada. The main object of the association is to discuss various forest soils programs of mutual interest.

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CONFEREES who attended the Northeastern Forest Tree Improvement Conference held at Mont Alto, Pa., on August 24-25.

Photo by Charles R. Lockard, U. S. Forest Service

Northeastern Forest Tree Improvement Conference

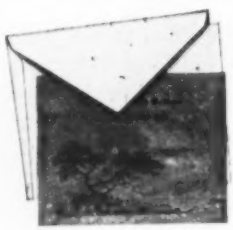
The second Northeastern Forest Tree Improvement Conference was held at the Pennsylvania State Forestry School, Mont Alto, Pa., August 24-25, with an attendance of 60.

A permanent organization was formed with the following officers elected to serve two-year terms:

Chairman, E. O. Ehrhart, Armstrong Forest Company, Johnsonburg, Pa.

Vice chairman, Scott S. Pauley, Cabot Foundation, Harvard University, Petersham, Mass.

Executive secretary, Ernst J. Schreiner, Northeastern Forest Experiment Station, Upper Darby, Pa.



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Industrial & Private

St. Regis Awards Scholarships

St. Regis Paper Company announces the award of five undergradute scholarships in forestry as part of its scholarship program for the academic year 1954-55. Three undergraduate scholarships are awarded in the South, and one each in the Northwest and Northeast. A fellowship in forestry was awarded earlier this year.

The scholarships in the South are provided, one each, at Alabama Polytechnic Institute, the University of Florida, and the University of Georgia. Each amounts to $800 a year for a period of two years, and is awarded to an outstanding Junior student at the schools mentioned.

Scholarship winners in the South were chosen by a committee composed of Regional Forester Charles Connaughton of the U. S. Forest Service at Atlanta, Georgia; C. Huxley Coulter, Florida state forester; and Albert Ernest, St. Regis vice president in charge of southern woodlands operations.

The winners of the southern scholarships are: John Donald Baxter, of Fort Payne, Alabama—Alabama Polytechnic Institute; Charles H. Barnes, of Panama City, Florida—University of Florida; and Jabez McCorkle, Jr., of Buena Vista, Georgia—University of Georgia.

The scholarship winner in the Northwest is Neil L. Zimmerman, of Oakland, Calif., a student at Oregon State College. He was chosen by a committee consisting of U. S. Regional Forester J. Herbert Stone; Robert Cowlin, director of the U. S. Forest Experiment Station at Portland, Ore.; J. M. Lamb, resident manager of the St. Regis mill at Tacoma, Washington; and A. B. Recknagel, St. Regis forestry consultant.

In the Northeast, the St. Regis scholarship winner is William W. Oliver, of Thornton, Penn., a student at the University of New Hampshire. The scholarship committee in the Northeast was composed of U. S. Regional Forester Charles Tebbe, Philadelphia, Pa.; John McGuire of the U. S. Forest Experiment Station, Upper Darby, Pa.; and Mr. Recknagel.

St. Regis offers each of the undergraduate scholarship winners employment during the intervening summer on some forestry project. Their continuance as recipients during the senior year depends upon their records in the field as well as in school. This is the second year of the company's award program.

Paul Casamajor Joins Research Organization

Paul Casamajor has resigned as forester-photogrammetrist at Shasta Forests Co., Redding, Calif., to take a position with Broadview Research and Development Co. of Burlingame, Calif. He will assist in the development of photographic interpretation research in connection with forestry, industry, and the U. S. military forces.

Gulf States Scholarships Announced

Three scholarships at Alabama Polytechnic Institute, Auburn, have been awarded by the Gulf States Paper Corporation, Tuscaloosa, Ala.

Warren S. Thompson, formerly assistant forester at Mississippi State College, has received the $2,000 H. E. Westervelt Forestry Fellowship made by the corporation in honor of its founder.

In addition two sophomore scholarships of $400 each were made available to Joe H. Williams and Kenneth Edgar Howell, students at the Institute.

A.P.A. Appoints Logging Engineer for Lake States Region

The American Pulpwood Association has announced the appointment of Henry M. Shepard as Lake States logging engineer. Shepard joins the APA staff as its third regional logging engineer, the others being headquartered in New Hampshire and Alabama.

Shepard comes to the A.P.A. from the Eastern Pulp Wood Company at Calais, Maine, where he was employed for the past nine years as assistant to the vice president and manager.

He has been an active member of the A.P.A. Northeastern Technical Committee for the past five years and is well acquainted with the association program and objectives.

His headquarters location in the Lake States had not been definitely established.

The field staff of the A.P.A. logging engineers in addition to Shepard is now comprised of: J. A. Holekamp, Sylacauga, Ala., covering Southeast, Southwest, and Appalachian regions; W. H. DeRosier, Gorham, N. H., covering the Northeast; and H. H. Jefferson, New York City, covering all regions on safety and training.

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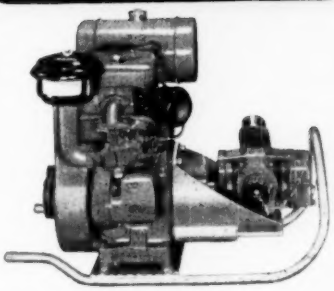

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Education

H. G. Wilm Attends Two European Conferences

Dr. Harold G. Wilm, associate dean for biological sciences and graduate studies at the State University of New York College of Forestry, was United States delegate at two international meetings in Europe in September.

Dr. Wilm attended the General Assembly of the International Union of Geodesy and Geophysics and the International Association of Hydrology in Rome, Italy.

He also represented the United States at the sessions of the Permanent Committee of the International Union of Forest Research Organizations at Nancy, France.

Before coming to the College of Forestry in 1953, Dr. Wilm was chief of Forest Influences in the U. S. Forest Service.

Dr. Wilm is the author of over 60 technical and semi-popular articles on forestry, hydrology, meteorology, and engineering, and is a past associate editor of the JOURNAL.

Durward Allen Joins Purdue Faculty

Dr. Durward L. Allen, formerly acting chief of the Branch of Wildlife Research, U. S. Fish and Wildlife Service, has been added to the staff of the Department of Forestry and Conservation, Purdue University, where he will be associate professor of Wildlife Management in the School of Agriculture and in the Agricultural Experiment Station. Dr. Allen holds degrees from the University of Michigan and Michigan State College. After his academic work, he was biologist with the Michigan Department of Conservation where he carried on a number of field investigations in the ecology and management of farm, game, and fur animals. During this period he had overseas duty in the Army.

Going to the U. S. Fish and Wildlife Service as biologist in charge of wildlife investigations on agricultural lands, Dr. Allen later became assistant chief of the Wildlife Research Branch in charge of all phases of federal wildlife research. Through his own research, writing, and lecturing, he has earned national recognition in the field of wildlife management, particularly in relation to practical methods for improving farm wildlife habitat. Among the books authored by Dr. Allen considered as major contributions to wildlife literature are *Michigan Fox Squirrel Management, Pheasants Afield,* and his most recent, *Our Wildlife Legacy.*

Dr. Allen will replace Dr. Donald E. Stullken who has moved to Pensacola, Florida, where he will be employed in the Naval Air Station School of Aviation Medicine.

University of Florida Receives Grant for Genetics Research

The wood using industry is supporting the forest tree genetics activities of the School of Forestry, University of Florida, in the form of a $20,000 grant, to be renewed annually for a 5-year period, according to Dr. C. M. Kaufman, director of the school.

Donors of the grant are pulp and timber companies in Florida and Georgia, plus a number of other wood using industries and interested individuals.

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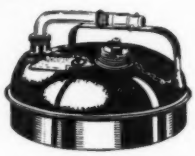

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The forest tree genetics program is organized to assist industry in the establishment of seed orchards of selected tree stock, provide graduate training in tree genetics at the School of Forestry, and broaden and intensify the forest genetics research program now conducted by the school. Dr. Thomas O. Perry, assistant professor, is in charge. He will be assisted by Dr. Wang Chi-Wu, formerly with Harvard University, and associate professor of Forestry in Kwangsi University, China.

The Florida Forestry Association was instrumental in arranging for this grant for forest genetics.

H. B. Attaway Named Supervisor Florida's Forest Ranger School

Herbert B. Attaway, Jr. has been named supervisor of the University of Florida's Forest Ranger School at Lake City.

He succeeds Clarke Mathewson who resigned to accept another position.

As supervisor and head professor of the Ranger School, Mr. Attaway will direct the program in technical and vocational forestry offered at the school.

The school is an adjunct of the University's School of Forestry and offers a one year course of technical forestry, as against the undergraduate and graduate program for professional forestry offered at the University.

Mr. Attaway joins the Ranger School staff from the position of forestry agent which he held since 1951 with the Atlantic Coast Line Railroad Company.

A native of Beaufort, South Carolina, he received both his B.S. and M.S. degrees in forestry from the University of Florida.

He is a veteran of World War II having served in the U. S. Coast Guard.

J. E. Carothers Joins Alabama Polytechnic Institute

J. Edwin Carothers, a native West Virginian, has joined the API forestry staff as assistant forester and assistant professor according to Dr. E. V. Smith, dean, School of Agriculture.

Carothers fills the position recently vacated by B. M. Cool who is on leave of absence studying for his doctorate at Michigan State College.

The new appointee holds the master's degree in agricultural economics from Iowa State College, and the bachelor's and master's in forestry from the University of Michigan. He has also studied at Salem College in West Virginia, Yale University, and Cornell University.

He has held positions as forester for Long-Bell Lumber Company, Shreveport, La.; junior forester and farm planner for the S.C.S. in Louisiana; forester in Alpine, Tenn., for the Board of National Missions, Presbyterian Church; and director of students at Frisbie House, Ames, Iowa.

S. K. Suddarth Joins Purdue Faculty

Dr. Stanley K. Suddarth, formerly associate director of Air Force Research with Statistical Laboratory, Purdue University, has joined the staff of the Department of Forestry and Conservation of Purdue. Dr. Suddarth will be engaged in wood utilization and timber engineering research in the Wood Research Laboratory.

Dr. Suddarth received his B.S. of Forestry from Purdue in 1943. Following graduation he served as a radar officer with the U. S. Marine Corps. During this service period, he received training in electronic engineering at Harvard and M.I.T. Upon his release in 1946, Dr. Suddarth returned to Purdue and obtained an M.S. in Mathematics and a Ph.D. in Agricultural Economics and Forestry. In January, 1951 he became a member of the Statistical Laboratory Staff and was appointed associate director in July of the same year.

Government

B. W. Henry Heads Southern Institute of Forest Genetics

Dr. Berch W. Henry has been appointed head of the new Southern Institute of Forest Genetics which the Southern Forest Experiment Station is establishing in southern Mississippi. The Institute will function as a part of the Station.

Philip A. Briegleb, director of the Station, New Orleans, said that Dr. Henry will immediately organize the Institute and start a program of research.

The institute is to serve the entire South, from Virginia to Texas. It will investigate fundamental problems in forest genetics, do applied research in tree selection and breeding, and serve as a demonstration area and source of information for forest genetics research and application.

The institute, it was stated, will in no way compete with other genetics work already being done by existing private, state, or federal agencies. Instead, it is intended to supplement and assist such work.

Headquarters will be at the Harrison Experimental Forest, about 20 miles north of Gulfport, Mississippi, on Highway 55. Offices, a laboratory, and

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a greenhouse were built on the forest during CCC days and will be expanded to serve the institute.

Dr. Henry has had training and experience in the development of disease-resistant strains of trees, including the southern pines. He received the bachelor's and master's degree from West Virginia University, his Ph.D. in 1941 from the University of Wisconsin for work in plant pathology and physiology. He was elected to membership in Phi Beta Kappa and Sigma Xi, national honorary societies.

During 1938-43 Dr. Henry assisted in a program of selection and testing strains of white pine for resistance to the blister rust. He also discovered and named the fungus causing the hitherto unknown oak wilt disease. From 1943-48 he served in the Naval Reserve and conducted civilian research for the Defense Department. In 1948 he commenced working on diseases of southern pines and has done original work on the fusiform rust and brown-spot needle disease.

R. M. Allen and Dr. Lloyd F. Smith of the Gulfcoast Research Center will transfer to the Genetics Institute, Briegleb stated. Along with new studies

BERCH W. HENRY

in genetics they will continue going projects such as the cooperative species-site tests and the work in pine regeneration and management.

Philip C. Wakeley, who for the past 28 years has directed the Southern Station's work in forest regeneration and genetics, will advise and assist the new institute. He will continue to be headquartered in New Orleans, where he will help coordinate the Station's genetics research with that of other federal and non-federal agencies.

Several entomologists at the Southern Station's Gulfport Forest Insect Laboratory will cooperate with the institute in developing insect-resistant strains and in protecting valuable breeding stock.

Howard Lull New Chief of Watershed Research in Northeast

The U. S. Forest Service has announced the appointment of Howard Lull as chief of the Division of Watershed Management at its Northeastern Forest Experiment Station, Upper Darby, Pa.

The announcement was made by Ralph W. Marquis, director of the experiment station. The Station's territory includes the entire Northeastern region from Maine to West Virginia.

Mr. Lull, a native of Elmira, N. Y., was previously assigned to the Forest Service's Southern Forest Experiment Station, where he was in charge of the Vicksburg Infiltration Project, a cooperative hydrologic research project

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Mr. Lull is a graduate of North Carolina State College. He did graduate work at Yale University and the University of Maryland. He worked three years in the Soil Conservation Service, and was in the Marine Corps three years, before joining the Forest Service in 1946.

In his new post, Mr. Lull succeeds Herbert C. Storey, who was promoted to chief of the Forest Service's Division of Watershed Management Research at Washington, D. C.

Harry Fowells to New Forest Service Staff Post

A new position has been set up in the Division of Forest Management Research in the Washington Office of the Forest Service because of increased emphasis now being placed on tree improvement, and the need to draw together on a national basis various studies in regeneration and silvics. Harry Fowells who has just completed a training detail in this office the past year has been promoted to the new position. In his assignment Fowells will serve as a staff specialist giving special attention to research related to regeneration of forest stands, silvics and forest genetics.

Fowells received his B.S.F. degree in 1932 and his M.S.F. degree in 1933 from Oregon State College. In 1934 he received an appointment with the California Forest and Range Experiment Station where he worked 20 years in various phases of natural and artificial regeneration of the California pines. He is well known for his many contributions in this field of research. Before coming to Washington, Fowells completed course-work requirements for his doctorate degree in plant physiology at the University of California.

C. K. Lyman and E. F. Barry to New Assignments

Chalmer K. Lyman, forest supervisor, Lolo National Forest, Missoula, Mont., has been transferred to the Washington Office of the U. S. Forest Service as assistant chief of the Division of Operation. He was succeeded in his position by Edward F. Barry, assistant division chief of the Division of Recreation and Lands in the regional office.

Lyman has been supervisor of the Lolo National Forest since April 1951. Prior to that time he served as staff officer of the Lewis & Clark National Forest at Great Falls and the Kaniksu National Forest at Sandpoint, Idaho. He is a graduate of Montana State University.

Barry was transferred three years ago from the supervisorship of the Clearwater National Forest to the regional office. He is a graduate of New York State College of Forestry and, prior to entering the Forest Service in 1933, was forester and pole inspector for the American Telephone and Telegraph Company in New York state.

Forest Entomologists Transferred

Leslie W. Orr has been appointed to take charge of the Southern Forest Experiment Station's research on forest insects according to an announcement by Philip A. Briegleb, Station director. He succeeds R. J. Kowal, who has transferred to Asheville, N. C., to head similar work at the Southeastern Forest Experiment Station.

Orr is a graduate of the University of Minnesota. In 1930 he received the master of science degree in forest entomology from the University of Michigan. Thereafter he pursued advanced studies at Minnesota, and conducted and administered insect research in

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Position available for area extension forester to conduct educational program in cooperation with county agents. B.S. in forestry required. Residence or experience in Kentucky or adjoining state preferred. Minimum salary $3600. **Address F. J. Welch, Director of Extension, Lexington, Ky.**

Positions Wanted

Graduate forester, Iowa State B.S.F. 1952, recently separated from military service; 26, married. Experience: timber-stand improvement, cruising, scaling, and growth prediction. Interested in training program in Lake States, eastern or western United States.
Box A, Journal of Forestry, Mills Building, Washington 6, D. C.

Graduate forester, 26, married. Experience: supervision of and marking for log, pole, piling, and pulpwood procurement; commercial thinning and other TSI work; management and acquisition inventories; planting, fire suppression, trepass. Presently assistant on large district. Desire location with consultant or other organization offering responsibility and opportunity.
Box B, Journal of Forestry, Mills Building, Washington 6, D. C.

Forester, B.S.F. Colo. A & M, M. F., Univ. of Michigan. Age 34, family, veteran. Now federally employed. Experience: cruising, mapping, timber marking, timber sales, stumpage appraisals, road locating, fire control and public relations. Desires field position, private or public, in West using cost control and forest management techniques.
Box D, Journal of Forestry, Mills Building, Washington 6, D. C.

Federally employed graduate forester seeks position with private industry in Lake States or Northeast. Age 34, married with family. Graduate work in Forest Management. Present position making and administering timber sales, land and timber appraisals, and general forest management over extensive area in Pacific Northwest.
Box E, Journal of Forestry, Mills Building, Washington 6, D. C.

Industrial forester available. B.S.F. 1940 Oregon State, age 40 years. 15 years' experience logging, land management, personnel supervision, construction, timber appraisal, timber cruising, fire control, logging engineer, and log scaling.
Box F, Journal of Forestry, Mills Building, Washington 6, D. C.

Wisconsin, Maryland, and Washington, D. C.

Since 1949 he has been at Ogden, Utah, in charge of the U. S. Agriculture Department's forest insect survey and control operations in the Intermountain region.

R. J. Kowal has been in charge of the Gulfport Forest Insect Laboratory since 1945. In this position he directed federal forest insect research in the mid-South and in the Panama Canal Zone. He has worked on problems relating to disease transmission by insects, protection of wood from termites and powder post beetles, and the detection and control of insects attacking living trees.

Kowal has a master's degree in forest entomology from the New York State College of Forestry, Syracuse University.

Interior Timber Cut Valued at $21,740,662

More than a billion board feet of timber were harvested from Department of the Interior lands during 1953, according to a compilation released by the department.

While the average value of timber taken shows a slight drop of 52 cents per thousand board feet, reflecting lower stumpage prices throughout the country, the timber was valued at $21,740,662 for the 1,348,711,000 board feet cut. This compares with the $22,680,683 valuation of the 1,363,572,000 board feet in the previous year's cut. The average value per thousand board feet in 1953 was $16.11 as contrasted with $16.63 in 1952.

On lands under the supervision of the Bureau of Land Management the volume sold totalled 615,173,000 board feet with a value of $11,647,390. In addition there were 4,583,000 board feet cut for "free use," valued at $34,475. The cut on the valuable Oregon and California Railroad revested lands in the State of Oregon was 520,004,000 board feet with a total value of $10,518,328. The "free use" cut on O & C lands was 228,000 board feet valued at $1,327. The cut on the public domain in continental United States totaled: United States, 81,693,000 board feet valued at $1,096,119; Alaska, 13,476,000 board feet valued at $32,863. "Free use" cut totaled: United States, 2,426,000 board feet valued at $30,968; Alaska "free use", 1,929,000 board feet valued at $2,450.

On Indian lands, timber sales were valued at $9,301,669 for the 575,787,000 board feet sold. "Free use" timber cut totaled 120,402,000 board feet valued at $265,939.

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Willamette Forest Genetics Research Center Reopened

In two steps aimed at strengthening forest research in the Douglas-fir region, the U. S. Forest Service has reactivated the Willamette Research Center and initiated a forest genetics program, both in cooperation with the School of Forestry, Oregon State College. Arrangements for establishing headquarters in Corvallis, Ore., have been completed, according to an announcement by R. W. Cowlin, director of the Forest Service's Pacific Northwest Forest and Range Experiment Station, and Dean Paul M. Dunn of the School of Forestry.

A major objective of the genetics research program will be improvement of Northwest tree species through plant breeding and careful selection of seed. In addition to new investigations planned, the project will serve as a basis for expansion of tree improvement studies begun by the Station as early as 1912. By concentrating future activities at Oregon State College, advantage can be taken of propagating and laboratory facilities as well as the opportunities of using test grounds in the Forestry School's McDonald Forest.

Leader of the newly reorganized work center will be Robert H. Ruth, who has been in charge of the Cascade Head Experimental Forest since 1946.

Carl M. Berntsen, his present assistant, will remain at the Experimental Forest as resident forester in charge under Ruth's direction. A similar position on the H. J. Andrews Experimental Forest will be occupied by Richard C. Koenig.

The position of forest geneticist in charge of the tree improvement research program has been filled by reassignment of Roy R. Silen, who has been forester in charge of the H. J. Andrews Experimental Forest since 1948. He will be quartered with the Willamette Research Center, and, under direction of the Portland office, will have regionwide responsibility for

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research in the genetics field. Dean Dunn and his staff will provide assistance in the development of the program. Investigations will be closely correlated with genetics studies now being planned by the School's Forest Experiment Station, the Oregon State Board of Forestry, the University of Washington College of Forestry, and the Industrial Forestry Association.

Both Ruth and Silen are graduates of the School of Forestry at Oregon State College. Silen received a master's degree in forestry at Yale Forestry School in 1948, and Ruth obtained a similar graduate degree at Oregon State in 1950.

Georgia Forest Research Council Launches Program

Cooperative agreements were recently completed between the Georgia Forest Research Council and three forestry agencies, the School of Forestry of the University of Georgia, the Georgia Forestry Commission, and the Southeastern Forest Experiment Station to develop and expand forestry research in Georgia. Under these agreements the School of Forestry and the Station received $26,000 for a coordinated tree improvement and breeding program. The School was also granted $4,000 to supplement its studies on the control of undesirable hardwoods. In addition, the Station received $10,000 for disease and insect control studies in connection with the state's 125,000,000 seedling nursery program. The Council provided $10,000 for the construction of a laboratory at the Macon facilities of the Georgia Forestry Commission. This laboratory will be used by the pathology, entomology and genetics research staffs for work dealing with problems of nursery production, seed testing and the general improvement of the quality of pine planting stock.

The Georgia Forest Research Council was created by the last state legislature to further the development of an adequate forest research program in the state. Governor Herman E. Talmadge appointed the following to serve on the Council: Wallace Adams, former state senator, Glenwood; J. J. Armstrong, manager, Woodlands Division, Union Bag and Paper Corporation, Savannah; Henry G. Garrard, state representative, Washington; Charles B. West, West Lumber Company, Atlanta; Mose Gordon, Commerce; T. E. Kennedy, Jr., state senator, Ashburn, and Guyton DeLoach, director, Georgia Forestry Commission, Atlanta. Funds to initiate the research program were provided by a grant of $50,000 by Governor Talmadge.

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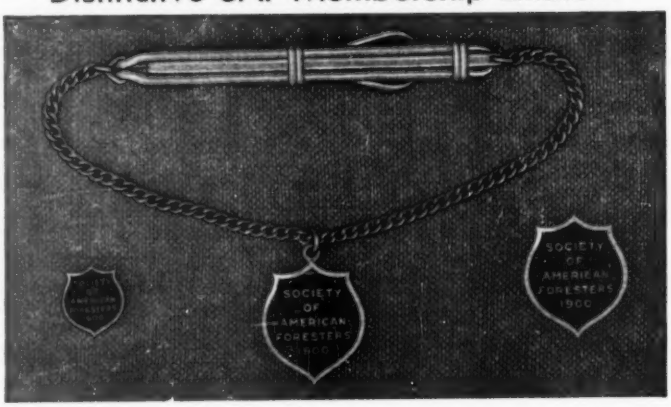

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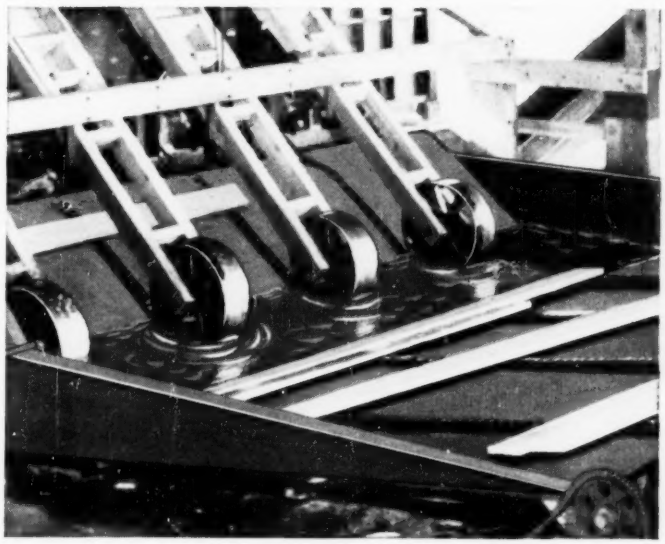

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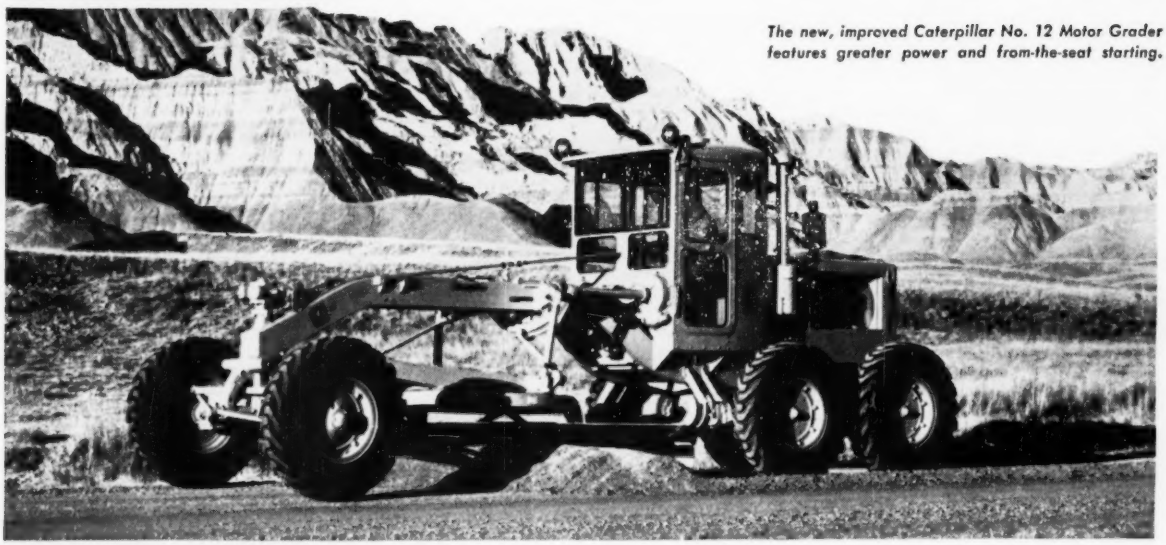

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